Agriculture

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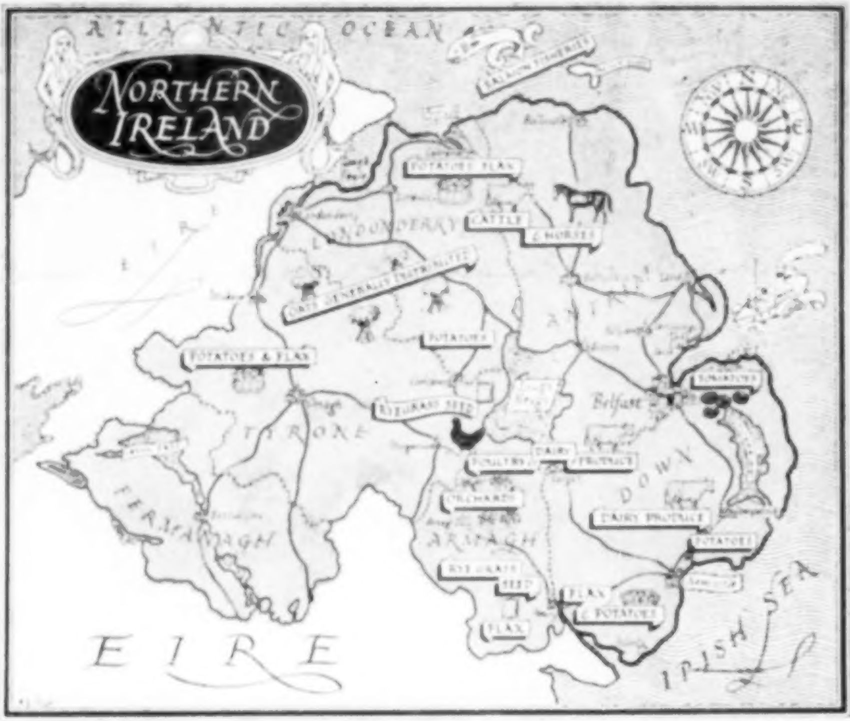
Lessons from the Counties



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AGRICULTURE

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Contents

	Page
The Effect of Nitrogen Top Dressings on the Yield and Protein Content of Winter Wheat. *H. W. Gardner*	1
Some Engineering Aspects of Grass Drying. *F. S. Mitchell*	9
Three Methods of Picking Potatoes : Rates of Work Output. *J. H. Smith*	11
Farm Buildings Conference at Hitchin. *N. K. Green and D. A. Hole*	14
The Limitations and Advantages of the New Insecticides. *Hubert Martin*	19
Pick-up Balers for Haymaking. *C. Culpin*	22
The Peach in England : 1. Historical. *A. H. Hoare*	27
Recent Changes in Horticultural Cropping. *C. E. Pearson*	32
The Treatment of Acarine Disease with Sulphur Fumes. *G. A. Ingold*	35
Foul Brood Disease of Bees Order 1942 : Summary Report for 1949	38
Outwintering on Sand. *N. F. McCann*	40
February Price Review	43
Book Reviews	45
COVER PHOTOGRAPH .. .. G. BERTELSMAN	

AGRICULTURE

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

VOL. LVII No. 1 APRIL 1950

THE EFFECT OF NITROGEN TOP DRESSINGS ON THE YIELD AND PROTEIN CONTENT OF WINTER WHEAT

H. W. GARDNER

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BEGINNING in 1943 and continuing until 1948, cereal variety trials were carried out on behalf of the Hertfordshire W.A.E.C. by the writer. The centres were spread over the chief types of soil found in the county and were mainly on commercial farms. The actual sites, though not a "random" sample, were decided by chance in the sense that anything the farmer had to offer was accepted. As a result, the level of fertility, as measured by the crop yield, varied greatly from place to place, e.g., in 1946 from 13.7 to 27.7 cwt. per acre for the winter wheats.

From the large number of excellent varieties of winter wheat, a selection of about ten was made to cover the chief types and countries of origin. Usually they were sown in single strips (= one bout = twice the drill width), the total area of a plot being from one-sixth to one-third of an acre. Wherever possible, a top dressing of nitrogen at the rate equivalent to 1½ cwt. per acre sulphate of ammonia (= .31 cwt. N) was applied about May 12 to randomly selected halves of *each variety strip* (not to one-half of the whole experimental area). For the effect of the nitrogen dressings statistical tests can be applied to each centre, whereas for the variety yields, the whole of the centres in a particular season formed a "county experiment," of which each centre constituted a "randomized block."

Harvesting was by binder or combine, the binder predominating in the earlier years, and the combine, particularly a self-propelled type, in the later ones. Yields of combined plots were corrected to a uniform moisture content of 13 per cent; binder-cut samples were hung up to dry in a Dutch barn for several weeks before threshing and were assumed to have reached a uniform moisture level.

Samples from individual plots were supplied to the Cereals Research Station, St. Albans, and were there tested for protein and vitamin B_1 content, and for milling and baking qualities.

Variety Yields It is not the purpose of this article to discuss all the relative merits of the different varieties, but the reader will probably wish to know how the yields compared in this fairly comprehensive test within a medium-sized county over a period of years. Nine varieties were constant in the four years 1944–47 and were tested at thirty centres. The average results are shown in Table 1.

The standard error of the general mean of the 270 plots was 0.16 cwt., so that the significant difference, at the 5 per cent point, between the means of thirty plots was 1.32 cwt. Scandia was greatly superior (1 per cent pt.)

to Juliana, second on the list, but this was not significantly above any of the others. Subdivision of the centres showed that Scandia was almost equally reliable on light, medium, and heavy soils, and also at centres of low, medium, and high fertility, as measured by the centre averages.

Jubilégem was included in twenty-two trials over three seasons, and averaged 21.75 cwt., as against 24.45 for Scandia in the same trials. Bersée was included at fifteen centres in two seasons, and averaged 23.20 cwt., as compared with 23.06 for Scandia.

Tests since 1947 have suggested that, so far as yield is concerned, Bersée is slightly superior to Scandia and is another variety which does very well over a wide range of soil and fertility conditions. The general results indicate that in Hertfordshire, and probably in neighbouring counties, the farmer could rely on a 10 per cent increase in yield by changing from Little Joss or Squarehead II to Scandia or Bersée, or any variety subsequently proved equal or superior to these two.

Table 1. Winter Wheat Varieties 1944-47

Average Yield at Thirty Centres

	cwt. per acre
Scandia	23.04
Juliana	21.17
Weibull's Standard	21.16
Desprez 80	20.87
Steadfast	20.63
Vilmorin 27	20.52
Holdfast	20.48
Little Joss	20.25
Squarehead II	20.09
General mean	20.91
Standard error	±0.16

Significant difference between means of thirty plots = 1.32

Effect of Nitrogen Top Dressing on Yield During the same period, 1944–47, nitrogen was tested at nineteen out of the thirty centres. The dressing as mentioned above was applied within a day or two of May 12 to a randomly selected half of each variety strip. Application was by hand.

The responses in grain are presented in Table 2. This shows the average yield for each centre, the average response for each centre with its own standard error, the average response of each variety in each year and also over the four years. At seventeen out of the nineteen centres, the mean response was significant, the two exceptions being the first and third centres listed. Taking the nineteen centres, the average response was an extra 3.66 cwt. of grain (standard error ±0.17), or if the yearly means are themselves averaged the response is practically the same—3.60. This response of just over 3.6 cwt. grain for a dressing of 0.31 cwt. of pure nitrogen may be compared with the estimate of 3.4 cwt. for 0.25 cwt. N given by Crowther and Yates* as the result of an examination of a large number of experiments on wheat. According to their response curve, 0.31 cwt. N should give 3.95 cwt. wheat, a slightly higher amount than that obtained in the Hertfordshire trials. Many more experiments would be needed to ascertain whether the difference is significant, and those experiments would have to include tests of the time of application, since it is possible that, owing to the dryness of the climate, the middle of May may sometimes be a little too late for maximum results. On the whole the two estimates may be considered to be in satisfactory agreement with one another.

* Fertilizer Policy in Wartime. *Emp. J. Exp. Agric.* April, 1941.

Variation of Nitrogen Response with Level of Fertility The number of centres is too small for a precise measurement of this variation, but there are enough to show that the response tends to be *higher* on fields of *higher* fertility—not, as one might expect, falling off as the undressed crop becomes heavier and heavier. In Table 2 the centres are arranged each year in order of rising fertility (as measured by the average yield of all the varieties), and it is evident from an inspection of the mean responses that there is certainly no falling off as fertility rises. For example, in 1946 the lowest centre with a yield of 13.7 cwt. gave an average response of 4.44 cwt., while the highest centre, with a yield of 27.7 cwt., gave a response of 7.08 cwt. An estimate of the significance of this effect can be obtained by dividing each year into centres of lower and higher fertility and putting together the lower halves to compare with the higher halves. This eliminates the influence of season. In 1945, when there were only three centres, the middle one can be used by adding half to each group and regarding the comparison as between 9½ centres. Overestimation of the results and also a slight adjustment to the standard error are thereby avoided.

	Average Yield	Average Response
	cwt.	*cwt.*
9½ centres of higher fertility	21.9	4.17
„ „ lower fertility	15.2	3.15
	Difference	1.02 cwt.

The difference, 1.02 cwt., in favour of the higher level of fertility is three times the appropriate standard error, 0.34, and is significant at about the 1 per cent point. It needs, however, to be emphasized that the small number of centres makes this an unreliable estimate which is strongly influenced by a few outstanding centres either high or low in response.

The no-nitrogen plots of the higher centres averaged 19.7 cwt.; on this the 4.17 cwt. of extra grain represents an increase of 22 per cent. The no-nitrogen plots of the lower centres averaged 13.6 cwt.: on this the 3.15 cwt. is an increase of 23 per cent. The percentage increases are almost the same at the two levels.

These results justify recommending a top dressing of nitrogen, even on a good crop, provided the variety is one which is unlikely to be laid.

Variation of Nitrogen Response with Variety In addition to giving the actual varietal response in Table 2, the order of these responses in each season is included to make it easy to detect the trend of results at a glance (1 = biggest response, 9 = smallest). On the average of all centres the maximum difference is between the two highest yielding varieties, Scandia and Juliana, for which the figures are 4.16 and 2.91, a difference of 1.25 in favour of Scandia. This is preferably tested for significance by applying the "t" test to the nineteen comparisons of the two varieties; it fails to reach the 5 per cent point. (The same conclusion is drawn by making use of the S.E. of the general mean to calculate a significance difference between the averages of 19 plots; this, as shown in Table 2, is approximately 1.50 cwt.). On the average of the four years the existence of varietal differences of response has *not* been established, but examination of the "yearly order" suggests that if the trials were continued, Scandia and Little Joss might be proved superior to Juliana in this respect. It is a point worth noting that both Scandia and Little Joss are rather later in ripening than Juliana.

Table 2

Extra Grain (cwt. per acre) from Dressing of Nitrogen fertilizer, applied during second week of May (see p. 1)

Year	Mean Yield of Centre	Mean N Response of Centre	Stand. Error of Mean Response
	cwt.	cwt.	
1944	13.2	1.16	0.78
..	17.1	1.82	0.72
..	18.4	1.22	0.60
..	20.8	2.79	0.69
1945	14.3	3.40	0.64
..	19.0	1.93	0.62
..	27.8	8.03	0.75
1946	13.7	4.44	1.20
..	18.3	6.51	1.05
..	18.4	4.61	0.85
..	19.5	3.74	0.95
..	22.4	5.31	0.96
..	27.7	7.08	0.85
1947	10.1	1.72	0.58
..	14.4	1.73	0.75
..	15.6	3.61	0.32
..	17.7	2.16	0.75
..	20.2	2.29	0.39
..	24.4	6.02	0.50
Gen. Mean 19 Centres		3.66	
S.E. of Gen.Mean		0.17	

Variety	Yearly Means for Varieties 1944	1945	1946	1947	Mean of Yearly Means	Mean of All Centres
Scandia	3.20	6.07	4.01	4.00	4.32	4.10
Juliana	1.42	4.50	4.33	1.68	2.98	3.01
Weibulls S.	1.48	6.17	5.77	1.93	3.84	3.71
Desprez 80	2.02	1.90	4.77	4.38	3.27	3.61
Steadfast	2.00	4.40	4.48	2.70	3.40	3.38
Vilmorin 27	0.72	4.87	6.08	2.80	3.62	3.72
Holdfast	1.28	3.87	6.93	2.05	3.53	3.71
Little Joss	1.70	5.13	5.37	4.03	4.06	4.14
Squarehead II ..	1.90	3.20	5.78	2.72	3.40	3.50
Mean of Year ..	1.75	4.45	5.28	2.92	3.60	Sig. Diff.
S.E. of Mean	0.39	0.36	0.36	0.23		1.50
Yearly Order of Variety Responses						
	1944	1945	1946	1947	Total	
Scandia	1	2	9	3	15	
Juliana	7	5	8	9	29	
Weibulls S.	6	1	4	8	19	
Desprez 80	2	9	6	1	18	
Steadfast	3	6	7	6	22	
Vilmorin 27	9	4	2	4	19	
Holdfast	8	7	1	7	23	
Little Joss	5	3	5	2	15	
Squarehead II ..	4	8	3	5	20	

In 1948, with Bersée replacing Desprez 80 in the above list, the average response at the six centres included in subsequent tables was 3.3 cwt.

Protein Percentage in the Grain Analyses for protein were started in 1945 but, owing to unavoidable mishaps to certain of the samples, the records are not complete for all varieties. Unfortunately these gaps occur mainly with two varieties in a single season and, although values could be calculated by the "missing plot technique," it has been considered preferable to deal with eight varieties for the three seasons 1946–48, for each of which six centres are available. Results are presented in Table 3. The protein of wheat is assumed to have 17.54 per cent N, instead of 16 as usually taken for protein, so the conversion factor for nitrogen to protein is 5.7 and not 6.25. This should be borne in mind when comparing the protein figures in this article with those in feedingstuff tables, e.g., a percentage of 11.4 here would be 12.5 in the tables—a difference of approximately unity. Moisture content is taken as 13.5 per cent.

The average results for the eighteen centres over three seasons show that Holdfast and Little Joss are very nearly equal at just under 10.5 per cent protein and are significantly superior to the other six varieties (0.26 is a significant difference at the 5 per cent level). Bersée and Squarehead II are about equal at 10 per cent protein and together are significantly above the remaining four which do not differ significantly amongst themselves. Holdfast has 0.86 per cent more protein than Scandia at the bottom of the list.

Table 3

Percentage Protein in the Grain (Av. of top-dressed and undressed plots)

Year and Centre Number		Mean Protein at Centre
1946	1	8.67
	2	9.15
	3	10.00
	4	8.79
	5	9.56
	6	8.80
1947	1	10.64
	2	9.51
	3	10.00
	4	10.85
	5	11.42
	6	10.29
1948	1	10.51
	2	10.71
	3	10.31
	4	9.29
	5	9.20
	6	11.06

Variety	Yearly Means for Varieties 1946	1947	1948	Mean of Three Seasons
Holdfast ..	9.72	10.78	10.85	10.45
Little Joss ..	9.97	10.97	10.33	10.42
Bersée ..	9.23	10.38	10.48	10.03
Squarehead II	9.22	10.82	9.83	9.96
Steadfast ..	9.00	10.25	10.02	9.75
Juliana ..	8.85	9.95	10.15	9.65
Jubilégem ..	8.33	10.35	10.12	9.60
Scandia ..	8.97	10.12	9.67	9.59
Year's Mean	9.16	10.45	10.18	9.93
S.E. of Variety Means	.145	.174	.144	Sig. Diff. .26

Yearly Order of Variety Means

	1946	1947	1948	Total
Holdfast ..	2	3	1	6
Little Joss ..	1	1	3	5
Bersée ..	3	4	2	9
Squarehead II	4	2	7	13
Steadfast ..	5	6	6	17
Juliana ..	7	8	4	19
Jubilégem ..	8	5	5	18
Scandia ..	6	7	8	21

It will be clear from the "yearly order of the variety means" that Holdfast and Little Joss consistently hold a high relative level, never falling below third place; their total scores differ only by one. Bersée also is very consistent, but Squarehead II is much more variable, coming second in 1947 (a very dry harvest) but falling to seventh in 1948.

Seasonal variations are greater than variety differences. In 1946 the harvest was extremely wet and the protein averaged 9.16 per cent; in 1947 the harvest weather was almost ideal and the protein was 10.45. The harvest of 1948 was troublesome but not really difficult, and the protein at 10.18 falls between the other figures.

Centres vary over a still wider range than years. The lowest centre average was No. 1 in 1946, when it was 8.67; the highest was No. 5 in 1947 with 11.42 a difference of 2.75. Within single seasons the maximum difference was 1.33 in 1946, 1.91 in 1947, and 1.86 in 1948. There was least variation in the driest harvest, but this cannot necessarily be considered as cause and effect since only three seasons are involved. It is a conclusion of considerable interest (and of importance in connection with the testing of varieties) that within such a small area so wide a variation between centres should be obtained each year.

There seems to be no connection between level of fertility and protein percentage, for if the centres are halved each year for lower and higher yields, the three lower halves average 9.95 and the three higher ones 9.92, which are almost identical figures.

In the 288 protein analyses used in compiling Table 3 the lowest was 7.64 for a Jubilégem sample and the highest 13.1 for a Holdfast sample. The general average 9.93, corresponds to 1.74 per cent nitrogen or, allowing for the 13.5 per cent moisture, to 2.01 in the dry matter. This is extremely close to the figure 2.03 obtained on the Broadbalk plots at Rothamsted for the ten years 1852–1861,* i.e., about ninety years ago!

Effect of the Top Dressings on the Protein Percentage

The recovery of the applied nitrogen may be obtained by an increase in crop, by an increase in percentage of protein, or a combination of these two effects. The former of these has already been discussed and the latter remains for consideration. The results are given in Table 4. The general average of varieties, centres and seasons is an increase of 0.36, with a standard error of 0.042, which is highly significant. The lowest seasonal increase was 0.05 in 1946, well below significance. The biggest increase was 0.74 in 1947, which is over twice the general average. The lowest increase in protein occurs in the year of greatest increase in yield of grain, and vice versa. If the three centres of lowest yield response each year are put together, the average increase in the protein percentage is 0.437; the comparative figure for the nine centres of higher yield response is 0.283, which is 0.154 lower. The standard error of this difference is 0.0832 so that the significance is approximately 15 to 1. There is *possibly*, therefore, a negative correlation between increases in grain and increases in protein percentage resulting from nitrogen, apart from a seasonal effect.

Experiments have already been started with both wheat and oats to find out whether, by applying nitrogen too late for it to have much effect on yield, an appreciable increase in protein content could be obtained. This practice has already come into use with hay and might therefore be expected to be successful with cereals. (Since top dressings are now being applied by aeroplane, the drawback of damage to the standing corn could be overcome!) An addition of only 1 per cent to the protein of oats would make an appreciable difference to its nutritive ratio and almost raise it to the group of foods "balanced" for a milk production ration.

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* See "The Rothamsted Field Experiments on the Growth of Wheat" : *Imp. Bur. Soil Science. Tech. Comm.* No. 40, 134.

The varieties differ considerably in their protein increases, Squarehead II, averaging 0.18, and Bersée 0.58. The variation of the varieties in the different seasons has also been large, Little Joss, for example, giving an increase of 1.08 in 1947 and a small decrease in the other years.

Table 4

Increase in the Protein Percentage due to Top Dressing.
(Average of Six Centres in each Year)

Variety	Yearly Means for Varieties			Mean of Three Seasons
	1946	1947	1948	
Bersée	0.05	1.06	0.64	0.58
Holdfast	0.07	0.85	0.73	0.55
Scandia	0.12	0.86	0.33	0.44
Jubilégem	0.07	0.63	0.35	0.35
Steadfast	0.16	0.77	0.08	0.34
Little Joss	—0.09	1.08	—0.29	0.23
Juliana	—0.02	0.60	0.07	0.22
Squarehead II	0.04	0.07	0.43	0.18
Mean of all	0.05	0.74	0.29	0.36
Standard Error { Variety Means	0.157	0.247	0.194	0.118
Standard Error { Mean of all	0.057	0.088	0.068	0.042
Extra Grain due to Nitrogen Av. of above varieties Cwt. per acre	5.92	2.84	3.49	4.08

The individual centres, not detailed in Table 4, vary greatly in each season. One farm near Tring has given a *decrease* every year, that in 1946 being a significant one. In 1947 the increases at the other five centres were all individually significant. It is clear from these results that continued experiments should make it possible both to select varieties which, on an average of seasons, give a greater response in protein percentage and also to detect the soil and climatic conditions associated with abnormal or subnormal increases. It is of particular interest that Bersée and Holdfast, which head the list for *increase* in protein percentage, are also at, or near the top, of Table 3, which gives the protein percentage itself.

Total Extra Protein produced by the Top Dressings From the increase in grain, the average protein, and the increase in protein percentage, the total additional protein resulting from the top dressing can be computed. From this the recovery of the nitrogen applied in the 2 cwt. of nitrogen is easily found, since the fertilizer has 15.5 per cent N and the protein 17.54. The results are given in Table 5.

The average of the 144 measurements in the three seasons was 0.462 ± 0.022 cwt., which is a recovery of 26.1 per cent of the applied nitrogen. There was not a big variation from year to year, and the standard error was also fairly steady.

In the wet harvest of 1946 the extra protein was 0.544, which is 0.123 cwt. above the average of the other two years. This difference has a standard error of 0.054 and is significant.

Holdfast and Bersée again come at the top of the table and are significantly above Steadfast and Little Joss at the bottom.

There was great variation between centres in each year, the highest with 0.81 cwt. extra protein (= 45.8 per cent recovery) and the lowest with no

extra protein, both occurring in 1948. Unfortunately local rainfall figures are not available for both centres, but the nil one lay in a small area noted for low summer rainfall, particularly in escaping summer thunderstorms, and this is a reasonable explanation of the exceptional result.

Table 5
Total Extra Protein due to Top Dressing
(Average of Six Centres in each Year)

Variety	Yearly Means for Varieties 1946	1947	1948	Mean of Three Seasons	Recovery of Nitrogen
	cwt. per acre	*cwt. per acre*	*cwt. per acre*	*cwt. per acre*	*per cent*
Holdfast ..	0.69	0.36	0.64	0.564	31.9
Bersée	0.79	0.50	0.40	0.562	31.8
Jubilégem ..	0.72	0.33	0.45	0.498	28.2
Scandia ..	0.37	0.56	0.54	0.492	27.9
Squarehead II	0.56	0.32	0.54	0.474	26.8
Little Joss ..	0.52	0.63	0.19	0.449	25.4
Steadfast ..	0.32	0.42	0.39	0.375	21.2
Juliana ..	0.39	0.26	0.19	0.280	15.8
Mean of all ..	0.544	0.424	0.418	0.462	26.1
St. Error { Variety Means	0.101	0.099	0.121	0.062	
St. Error { Mean of all	0.036	.035	.043	0.022	
Recovery of N per cent	30.8	24.0	23.6	26.1	
Extra grain due to N *cwt. per acre*	5.92	2.84	3.49	4.08	

For the estimation of the total recovery of the nitrogen, weights and analyses of the straw would be necessary. From the few centres cut by binder the extra weight of straw due to the nitrogen is estimated at 8 cwt. Assuming 0.5 per cent of nitrogen in this, the recovery would be 13 per cent which, added to that in the grain, gives a total of approximately 40 per cent.

Summary Summarizing, the main results are: Bersée and Scandia are outstanding varieties for yield over a variety of soil and fertility conditions in Hertfordshire; the average response to a top dressing of nitrogen at the rate set out above (p.1) applied in the second week of May, is 3.6 cwt. of grain: the response varies greatly from season to season and from place to place, but dependence on variety has not been established, though it is suggested; the response is considerably higher on the centres of higher fertility; Holdfast, Little Joss, and Bersée average above 10 per cent of protein, and of these three Bersée is significantly below the other two; the protein percentage on the average was increased by the nitrogen to the extent of 0.36, with Bersée and Holdfast above 0.5 and occasionally reaching 1.0; the extra protein due to the nitrogen averaged 0.46 cwt. per acre, with Bersée and Holdfast giving 0.56; the average recovery of the applied nitrogen was 26 per cent in the grain.

Next month Mr. E. N. Greer of the Cereals Research Station, St. Albans, will discuss the milling and baking qualities of the varieties and how they were influenced by the top dressings.

SOME ENGINEERING ASPECTS OF GRASS DRYING

F. S. MITCHELL, B.Sc.

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DURING the last few years considerable interest has centred on the relative merits of the low-temperature type of grass drier, most common in this country, and the high-temperature type, used extensively on the Continent and in the U.S.A. So great has been that interest, that at the end of the war it was decided to import into Britain from the Continent examples of a few selected makes of high-temperature driers, so that they could be tried out under British conditions.

To date only one make of high-temperature drier has been imported in any number, and there has been little opportunity of carrying out comparative trials, as it is only recently that a low-temperature drier of comparable output has been produced in this country. A good deal of isolated information on the performance of both types has, however, been collected. This article surveys the main features of both types of drier so as to provide some guidance to farmers, or groups of farmers, who have a crop-drying project in mind. It is also intended to draw attention to a number of important problems which have to be solved, irrespective of the type of drier chosen.

High and Low Temperature Driers A grass drier is simply a means of evaporating surplus water from fresh grass so that the moisture content of the final product is sufficiently low for it to be stored for an indefinite period. The evaporation must, however, be carried out without impairing the feeding value of the dried product. In young grass the main constituents are susceptible to damage by overheating; especially small particles such as clover leaf, which dry more quickly than stems and larger particles.

The evaporation of water from young grass takes place in stages. In the first instance the rate of drying, down to a moisture content of approximately 45 to 50 per cent, is in direct proportion to the temperature and velocity of the drying gases. The humidity must be sufficiently high to keep the material from being scorched. In the second stage of drying, the moisture must reach the surface of the grass cells by diffusion before it can be evaporated; the water is more difficult to drive off and the grass is more likely to be damaged by overheating than in the first stage. The rate of drying is very much slower and the thermal efficiency of the drier may be reduced, unless some compensating means are introduced.

In practice, therefore, the whole drying process must be carried out at a relatively low temperature or if a high temperature is used, it is essential for the individual particles to be removed from the drying process the moment they become dry and before they begin to be damaged by heating.

With the low-temperature type of drier the grass is dried in the long state, on trays used in pairs to give continuous drying, or on a continuous band conveyor. The gases from the first stage of drying are allowed to escape, but in the second stage the partially saturated gases are re-circulated and re-heated before being passed again through the first stage. When drying grass with a moisture content of 80 per cent to a dried product of 10 per cent moisture, these driers have, for the most part, been designed to give an output of around 4 cwt. an hour, although bigger driers, giving up to a ton an hour, have been produced.

The use of high-temperature driers is a more recent development. Because of the greater overall drop in temperature, it has been claimed that they give a much more efficient method of drying, with a corresponding reduction in the power required to circulate the smaller quantity of air necessary.

With these driers the material must be chopped finely—not greater than 1-inch lengths—so that the selective removal of the dried particles can take place.

Temperature Control and Thermal Efficiency With the high-temperature pneumatic type of drier, the main aim is to maintain a constant outlet temperature. This can be done by adjusting the inlet temperature to the variations in the moisture content of the wet material and by arranging minor fluctuations in the rate of feeding. While the control of such a drier does not necessarily call for an operator with an extensive knowledge of engineering, it does require one of sufficient intelligence to appreciate the principles on which the drier is worked.

With low-temperature driers, the inlet temperature should be kept constant (preferably by means of a thermostat) and the efficiency of the drier, as shown by the exhaust gas temperature, maintained by controlling the rate of travel of the conveyor, or with a drier of the tray type, by the length of drying time. This gives a simple means of control which will ensure a reasonably constant rate of evaporation, even in the hands of relatively unskilled labour, and especially where a constant depth of grass can be maintained by the use of an efficient self-feed. All low-temperature driers should be fitted with a thermostat to control the temperature of the inlet gases. Ancilliary equipment, such as a thermostat to maintain a constant exhaust-gas temperature by regulating the rate of travel of the conveyor, and the use of a self-feed, although it adds to the capital cost of the outfit, has been shown to increase the general efficiency of the drier in both labour requirement and output. With high-temperature driers, the use of automatic feeds and thermostat controls is practically essential if they are to work satisfactorily for an appreciable length of time.

Claims that high temperature leads to an increased thermal efficiency and, therefore, to reduced fuel consumption and cost of production, have not been borne out by experience. Normally, in commercial practice, thermal efficiency is measured as the quantity of fuel consumed for a given output of the dried product. The capacity of the drier is, however, measured not by its ability to produce dried material, but by its ability to evaporate water. The true efficiency of the drier is the quantity of water which can be evaporated by any given quantity of fuel; the weight of the dried product varies with the moisture content of the original material.

Thermal efficiency can vary within fairly wide limits according to the skill of the operators. Figures have been recorded as low as 40 lb. and as high as 100 lb. of water evaporated per gallon of oil consumed. General observations have also shown that for both types of drier a higher level of efficiency can, on the whole, be maintained where automatic controls are used, so that little reliance needs to be placed on the skill of the operating team.

Quality of Product In view of some misunderstanding on the subject, it should be made clear that quality is generally understood to refer to the protein content, although for some it may also include the beta carotene. It is well known that the protein content of the dried product may vary widely, due, for example, to the stage of growth at which

the crop is cut. No drier can produce a higher protein product than the fresh material from which it came. Any such apparent gain is evidence only of burning the carbohydrates during drying. Recent tests carried out in this country, in which the digestibility of the protein was chemically estimated, have shown that high-temperature driers of the pneumatic type have no appreciable effect in reducing the digestibility of the protein in the dried product compared with that in the wet material. Losses in dry matter of between 5 and 10 per cent due to burning have been recorded in a few instances. Similar results have been obtained with low-temperature driers, although here the loss was in the region of only 3 per cent. Apart from actual burning, care must be taken with both types of drier to avoid scorching the dried material.

Labour The man-power required for any type of drier will depend upon the type of labour used and the extent to which labour-saving equipment is employed, both in feeding the drier and in disposing of the finished product. When comparing driers of equal capacity and employing the same labour-saving devices, there is no evidence to support the contention that a greater output per man-hour can be obtained from a high-temperature drier than from a low-temperature drier; the labour required relates simply to the quantity of grass to be handled. Comparisons made in labour requirements have in many cases not been valid, since they have merely compared a high- and low-output drier. Within certain limits the higher output drier is certainly more economical in labour, but this applies to both high and low-temperature types.

THREE METHODS OF PICKING POTATOES

RATES OF WORK OUTPUT

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WHERE extensive acreages of potatoes are grown, difficulty is not infrequently experienced in getting sufficient labour for lifting and storing the crop. It is important, therefore, to seek methods of harvesting which will reduce the manual labour used per ton of crop lifted. Speed in harvesting reduces the cost by ensuring that the task is accomplished under the most favourable weather conditions. Even with the best organization of workers and machines, a break in the weather reduces the rate of work output per man-hour. Further, by ensuring that the greatest possible amount of the crop is stored in dry condition, the risks of heavy loss in the clamp or store and the costs of sorting and sacking are reduced.

The most common method of storing potatoes is, of course, in clamps, and in the main potato-growing areas the potatoes are carted to the clamp loose. In some other districts the crop is stored in farm buildings; and in recent years a number of farmers have constructed potato stores with baled straw. Where the crop is to be stored in buildings or baled straw clamps it is often found most convenient to sack the potatoes on the field for ease of

handling at the store. Even when storing in ordinary clamps some farmers, because of the smallness of their organization, find it more convenient to use sacks.

Picking practices vary. In some districts women pick into aprons, but the more common method is to pick into buckets or baskets and to empty these into carts, hampers or sacks. In some parts of the U.S.A. potatoes are picked directly into sacks with the aid of a picking belt. The picker attaches the sack to himself in such a way that when he bends down to pick, the open mouth of the sack is close to the ground and near the picker's hands. The man straddles the sack, and as he moves forward he pulls the sack with him. A few farmers in this country used these belts last year, and the general opinion is that when potatoes have to be put into sacks the picking and sacking can be done more quickly with the aid of belts than by the old practice of emptying full buckets and baskets into sacks.

Three Methods of Picking Investigated As part of an investigation into manual labour time required to perform some tasks associated with the harvesting and storage of potatoes, a study was made of the following three methods of picking:

a picking into baskets and leaving them to be emptied by other workers into tractor-trailers.
b picking into baskets and emptying the baskets into sacks.
c picking directly into sacks with the aid of picking belts.

The team of pickers consisted of two groups of eight men, each group dealing with one of the two rows of potatoes which were opened during each complete journey by a mounted spinner. The length of row was divided amongst the eight men in each group. The study was confined to one group, and a note was made of the time taken by each man to pick his length of each row. The field was of irregular shape, and the men at each end of the rows had stints which varied in length. The results are, therefore, confined to the picking times of six men.

The test lasted three days. The "basket-and-sack" method was used during one full day and during the early part of the other two days. The data presented for each method are therefore restricted to work done during the period from the lunch-time break at ten o'clock to the end of each day. The actual length of stint allotted to each of the six pickers varied from 46 yards on the first day to 54 yards on the last day, but for purposes of comparison the picking times have been adjusted to the times required to pick 50 yards of potato row. The total length of row picked each day by the men was approximately the same.

The investigation showed that the pickers could deal with their length of row most quickly when they left their full baskets to be emptied by other workers. The average time taken by the six men to pick their stints on each of ten rows was 13.09 minutes per 50 yards of row. When they had to empty their baskets into sacks the average time taken for the same length of row was 16.05 minutes, the extra time being required to empty their baskets into the sacks. The picking belt reduced the time taken to pick and sack potatoes to 13.61 minutes per 50 yards of row.

Careful Team Selection When the rows are divided into stints and opened by a spinner the speed of work output is governed by the slowest worker. It is important, therefore, to note the effect of different methods of picking upon the speeds of each worker in the team. The recorded picking times of each worker showed that they were all able to deal with their length of row most quickly when the full baskets were left

to be emptied by other workers. Further, each picker was able to pick directly into sacks with the aid of the American belt more quickly than by picking into baskets and emptying these when full into sacks. For the slowest worker the differences in times under each of the three methods were of the same magnitude as those indicated by the average times noted above.

This investigation emphasized the importance of carefully selecting the team of pickers. Under each of the three methods used there was a difference of between two and four minutes in the speeds of picking 50 yards of row by the fastest and slowest worker. The difference was least when the pickers left their full baskets on one side and the slowest worker then took 20 per cent longer than the fastest picker to deal with 50 yards of row. Under the other two methods the differences were about the same, the slow worker requiring just over a quarter more time than the fastest picker to deal with an equal length of row. These differences in speeds of working are important, and when slow and fast workers are included in the same team the fast workers may have long rest periods between each row.

When potato lifting is done at piecework rates slow workers rarely have a chance of being accepted in the team by the other workers; and when they are included in the team they have to accept a shorter stint and a lower rate of earnings. If the team is working at ordinary day rates the farmer can either remove the slow worker from the team or give him a short stint and pay the other members of the team a higher rate of wages for the longer stints. The slow worker cannot be paid less than the appropriate statutory minimum wage unless a permit has been obtained. The important thing is to avoid allowing one or two pickers to slow up the speed of the team.

Pattern of Daily Work Output Prior to the commencement of this inquiry the team had spent several days picking potatoes and had by then got over the stiffness which develops during the first few days of back bending. The men, however, experienced some stiffness at the beginning of the day, and the time taken to pick the first row was longer than the average for the day. The inquiry showed that the general pattern of work output over the day was very similar to that found in many other industries. At the beginning of the day the rate of work output is low, and it quickens during the middle of the morning. Just before and immediately after the lunch and dinner breaks the speed of picking slackens. A high speed of work output is maintained during the afternoon. It slackens off again towards the end of the day, but the time taken to pick the last row of the day is shorter than that taken on the penultimate row. The reason for the difference in the picking times of these last two rows of the day is due to the fact that the team tends to regulate its speed towards the end of the day so as to be sure of finishing in good time. The fact that the men are usually allowed to go home on completion of picking the last row encourages them to increase their speed on that row.

Summary The results show that a team of pickers can deal with a given area of potatoes most quickly when they pick into baskets which are left to be emptied by other workers. This advantage is partly offset by the longer time taken to load loose potatoes into carts or trailers; thirty-five cwt. of potatoes in sacks required nine minutes less of manual labour time than did the same quantity tipped from baskets. There is general agreement that it is more economical in labour time to handle loose potatoes at the clamp, particularly if tipping carts or trailers are used. That being so, the whole operation of picking and clamping can be done with the minimum expenditure of labour when sacks are not used.

Where, however, it is the practice to store the potatoes in farm buildings, it may be necessary to have the potatoes put into sacks. In such cases it may be found desirable to use the picking belt. Farmers and workers who have used the belt are satisfied that it increases the speed of picking and sacking. Experience shows that the workers and the sacks to be used must be carefully selected. The team must consist of men of good stature and physique who are able to straddle half sacks of potatoes and to move easily with these sacks attached to the belt. The men who used the belts stated that they experienced no difficulty or discomfort. They cannot, however, be recommended for use by boys or women and girls.

FARM BUILDINGS CONFERENCE AT HITCHIN

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Agricultural Land Service

A ONE-DAY conference on Farm Buildings held by the Hertfordshire Agricultural Executive Committee in the Hermitage Hall, Hitchin, on January 26, 1950, attracted a large audience which included representatives from as far afield as Scotland.

Mr. J. Findlay, of Rickmansworth, speaking on the subject of Cowsheds, advised that the most careful consideration should be given to the choice of a convenient site and that the advice and criticism of friends, relations, and neighbours should be sought and pondered before a brick is laid. Mr. Findlay has adopted many of the essential recommendations in *Post-War Building Studies No. 17*,* but laid stress on a number of points. The most economical type is a double-range shed, 27 feet wide with light steel roof trusses carried on 4-inch square steel stanchions 10 feet apart, the walls formed of 4½ in. brickwork, 9 feet high to the eaves, with an asbestos sheeted roof. Light and ventilation can be obtained most satisfactorily by laying 2-feet glass panes the whole length of the ridge on either side, leaving a gap of 4–6 inches between the top edges. Any rain that comes in falls in the middle of the gangway and does no harm. Inlet ventilation can be provided by apertures through the walls 5 feet 6 inches above the floor, over which a box without a lid and with one side missing is hung to prevent direct draughts. One inlet should be allowed for each pair of cows. Stall divisions can be built of bricks laid on edge and rendered in cement, the corners being rounded off. These are strong and are cheaper than other types. Mangers should be of the Scottish type, of glazed fireclay, and water-bowls should be placed 2 feet out from the stall division and fitted with nose plates at the back—not at the bottom. All doors should be sliding. Feeding passages are an unnecessary luxury.

Finally, Mr. Findlay strongly criticized the high cost of many cowsheds being put up today. He considered that if a farmer uses farm labour for all but the highly skilled work, a good cowshed could be built for £35 per cow, which compares with a pre-war cost of £10 to £12 10s. per cow.

* H.M. Stationery Office, 3s., 3s. 4d. (by post).

Milking Parlours MR. R. N. SADLER of Burnham-on-Crouch spoke on milking parlours and drew attention to the advantages of the milking parlour over the cowshed. He described how he had joined his uncle in helping with a herd of 70 cows, hand-milked by six or seven workers. They are now keeping two such herds, with three small "one-man" units. The large herds are milked on the parlour system. Two of the smaller herds are milked by hand and the other by bucket machine.

Mr. Sadler said that in producing milk whatever the system adopted, certain essential requirements must be fulfilled. The cows must be housed as comfortably and as healthily as possible. They must be given individual attention, particularly the high-yielder. Labour must be reduced to a minimum, and the milk must be kept clean. He was not sure that the first requirement was met by the erection of a new cowhouse of the type described by Mr. Findlay, but he emphasized that the installation of a milking parlour was not necessarily the answer to the problem on every farm. It was, however, a system by which the use of existing buildings, whether they were yards, stocksheds or other accommodation, would result in most cases in a considerable saving in cost over even the low figure of £35 per cow quoted by Mr. Findlay. Further, a considerable saving in labour can be achieved. In his own case, three men are employed with the 70 cows; the third man did not need to be a skilled cowman and could be used on other work during the summer.

Mr. Sadler stressed the importance under this system of dividing the herd into small bunches, keeping the heaviest milkers together and making changes only when absolutely necessary. In this way fighting is reduced. It is, however, a good plan to cut off the horns, which is not a very troublesome operation and is better than dehorning at birth.

An interesting discussion followed. One speaker considered that feeding passages were well worth the extra cost of building and thought that the height at the eaves quoted by Mr. Findlay could be reduced. Mr. W. R. Kemsley gave the cost of erecting a parlour 33 feet × 17 feet in 1948 as £1,000. This would deal with 25 cows, but he pointed out that half the cost was attributable to the cost of plant in the parlour, a fact often overlooked in comparing the relative costs of parlours and cowsheds.

A speaker from Ayrshire criticized the 4-inch rise from dung channel to centre walk advocated by Mr. Findlay and said that ¾ inch was all that was necessary; the cows would not then jump the channel. Another speaker advocated rounding off the step to allow a cart to be taken more easily along the shed, but this was not accepted by Mr. Findlay on the grounds that a back step was useful for a cow to push against if it slipped down.

MR. WILLIAM ALEXANDER spoke on the adaption of buildings for T.T. milk production. He supported Mr. Findlay in his use of bricks on edge for stall divisions and in his figure of £35 per cow as the cost of a new shed. He advised his hearers to consider most carefully the costs and the continued saving in labour between a new shed properly sited and planned and an old building not providing those essential requirements. In most cases the only difference in cost would be the roof, and the roof of a new building supported on stanchions could be erected by a contractor for £2 per yard super or £15 per cow. The rest of the work is usually common to new and old buildings and can largely be done with the farm staff.

He favoured the "Portal Truss" with chamfered purlins, on which dirt would not lodge and self-closing sliding doors which would stay open if pushed right back. A 2½-feet wide dung channel was useful, 2 feet 9 inches was better and 3 feet was the best, as the droppings did not normally fall more

than 2½-feet from the step. He considered that an "uncomfortable slope" in the angle of the gutter behind the cows was desirable to make them keep up on the standing and thought that there should be a 6-inch continuous opening in the ridge for outlet ventilation and a 6-inch inlet pipe through the wall at manger height with a convex baffle plate fixed over it and blocked off about an inch. In addition he advocated a 3½-inch fall in the standing of 7 feet 6 inches—cows are happier with their front feet higher than their hind feet. Feeding passages might be included if thought worth the cost, but the rails at the head of the cows should be set back 9 inches from the top edge of the manger to allow easy filling. Other suggestions were, a raised manger 3 inches above the floor with shallow bottom formed by splitting an 18-inch half-round glazed pipe down the centre, and ¾-inch graded shingle, coarse sand and cement for making the concrete floors, which wears better and proves less slippery than a surface finished with carborundum.

MR. F. RUSSELL-WOOD of Kimpton, winding up the discussion, pointed out that fixed mangers were useful as emergency water-troughs if the supply to the bowls failed. He referred to the excessive wear which occurs in dairy floors and suggested that steel sheets were the only effective covering. Steps in dairy buildings should be eliminated wherever possible.

Conditioning of Grain MR. J. C. HAWKINS, Senior Scientific Officer, National Institute of Agricultural Engineering, dealing with the conditioning of grain, explained the theory underlying the successful drying and storage of grain and the methods adopted in practice. He said that grain is a living seed which has a moisture content varying with the relative humidity of the atmosphere. If harvested early in the morning or under damp conditions, the grain may have a moisture content of as much as 23 or 24 per cent, and if stored in that condition the result will be rapid respiration of the grain, accompanied by an increase in temperature. This rise in temperature in turn induces a quicker rate of respiration, and if this vicious spiral is not checked mould develops, the grain is less nutritious and germination is affected. If, on the other hand, the grain is harvested on a sunny afternoon under the driest possible conditions, it may have a moisture content as low as 14 per cent, in which case it can be stored with safety because it is virtually dormant, respiration is slowed down, and the vicious spiral referred to above will not develop.

The object of grain drying is, therefore, to reduce its moisture content to a percentage suitable for the particular type of container used and the period for which it is to be stored, while at the same time avoiding the unnecessary expense of over-drying and risk of damage to the grain. As illustration he gave the following figures:

For long term storage in bulk the moisture content should be 14 per cent.

For short term storage in bulk the moisture content should be 14–16 per cent.

For long term storage in sacks the moisture content should be 16–18 per cent.

For short term storage in sacks with open tops a moisture content of 18–20 per cent would be safe.

Mr. Hawkins went on to indicate how a farmer should deal with his grain to the best advantage. Considering first the question of combine harvesting, he said the first aim should always be to use the combine if possible only when the moisture content of the crop was naturally low, i.e., after the dew had evaporated in dry weather, and this could be achieved more easily by

having a harvester rather on the large side than on the small. Secondly, the grain should be cleaned of greenstuff and rubbish before being dried or stored, otherwise the rate of drying would be reduced or moulds would develop in the bulk of the grain. Thirdly, where it was necessary to dry the grain, one of the following methods could be adopted:

1. By putting it through a continuous grain drier
2. By drying it in bins or silos of the ventilated type
3. By drying it in sacks

The principle underlying all these methods was to cause air of lower relative humidity than the grain to remove moisture from it, and this could be done by raising the temperature of the air to be circulated by 10°F.

Ventilated Bin-type Installations Mr. Hawkins outlined the essential requirements of any ventilated bin-type of installation suitable for farms of medium size. The plant should be capable of passing air through the bulk grain at a velocity of 10 to 12 feet per minute. The air ducts to the bins should be large in cross-section, say 2 feet × 2 feet, as much more power is needed to force that volume of air through smaller ducts. The air entering the ducts should be at a constant temperature of 10°F. above the temperature of the outside atmosphere. The air should be warmed, if possible, by electricity because the fumes from solid or oil fuel, if used directly, may affect the grain adversely. The false floors of the bins should be porous to allow air to pass through them; foamed slag is as yet the most suitable material. The floors of the bins should be horizontal, otherwise the flow of air through the bulk of grain will be uneven.

He thought it unwise to attempt to dry in a bin grain that is more than 10 feet deep. At that depth it would take 10 days to dry at an initial moisture content of 20 per cent. If the initial moisture content exceeds 20 per cent, the grain should not be more than 5 feet deep. It should be possible to empty all bins easily and to turn grain from one bin to another. Other points to bear in mind in considering a ventilated bin type of installation are:

(*a*) It is less costly than a continuous drier with non-ventilated bins;

(*b*) There is no danger of overheating the grain;

(*c*) Other crops besides grain can be dried;

(*d*) It is suitable for about 150–300 acres of cereal crops.

Mr. Hawkins stated that the underlying principle of sack drying is also to dry the grain by means of warmed air, but in this case it is dried in 1 cwt. bags placed upon openings in a concrete platform which is hollow underneath, the hollow being in effect an air duct. The necessary heating and fan unit could be purchased for £250, and 40–50 bags could be dealt with at a time. Such an installation costs about £330 in all, excluding buildings, and would be suitable for a farmer growing up to 150 acres of grain or as an auxiliary unit for a larger acreage. Grain is dried at the rate of 1 per cent moisture removed per hour and there is no need to turn the sacks.

Buildings for Grain Storage The last paper of the conference was entitled "Provision and Adaptation of Buildings for Grain Storage" and was read by Mr. H. H. Hollinrake, Farm Buildings Advisory Officer, Eastern Province, who proceeded to deal more fully with the building aspect of the installations already mentioned by Mr. Hawkins.

When choosing the site for a new installation or choosing an existing

building for adaptation, it is necessary to bear in mind the length and direction of the routes over which the grain would need to be carried, and the form of power to be employed for conveying the grain and heating the air. Furthermore, a waterlogged site should be avoided.

It was necessary to be very careful about using the walls and floors of existing buildings for supporting grain in bulk. The lateral and vertical pressures exerted by such grain were very great, and generally it was wise to erect suitable bins or silos as self-contained units inside an old building, rather than to pile the grain directly against the old walls.

Where the erection of a *new building* to house a grain-storage installation is contemplated, Mr. Hollinrake's own preference is for one of pre-cast concrete construction, roofed with corrugated asbestos cement sheets; but the Dutch barn type of building, or one erected with Ministry of Agriculture standard components, is equally suitable. Whatever the type of building, there is no need for it to have four complete walls. In addition to the roof, all that is necessary is sufficient vertical cladding or sheeting from the eaves downwards to prevent driving rain from entering the open tops of the silos.

On the subject of layout, Mr. Hollinrake stressed that planning should start, as it were, out in the fields with the combine harvester, because of the need to take into account such essential considerations as the total tonnage of grain to be handled; the rate at which it would come in from the fields; the type of installation to be used, i.e., whether continuous drying or ventilated bins; and the system to be used for the conveyance of the grain in the building or buildings.

Having enlarged on these points, he went on to discuss the question of bins and silos—their shape, size and method of construction. They could be rectangular or circular; the latter took up about 25 per cent more space, but could be easily dismantled if need be. Materials used could be pre-cast concrete, *in situ* concrete, concrete blocks, brick, timber or steel; but pre-cast concrete is by far the cheapest initial cost. The material used does not affect the condition of the grain stored in it. Provided the grain is properly dried, the moisture content will remain static regardless of the material of which the silico is made.

On costs, Mr. Hollinrake said he found that, where an existing building was used, a grain storage and handling installation for about 200 tons worked out at about £5 to £10 per ton. Where a new building had to be provided, those figures could be approximately doubled. These were contractor's prices.

In the discussion which wound up the Conference the following points were brought out:

1. When deciding on the number and size of bins for any particular installation, it is preferable to have a set of small ones rather than two or three large ones.
2. A pneumatic conveyor system is most convenient for use in existing buildings, and barley is not damaged, provided the ducting is well designed and bends do not have a radius of less than five times the diameter of the ducting.
3. Self-emptying bins or silos with steeply sloped floors waste space if they are unlikely to be emptied frequently.
4. A moisture meter is useful until experience of handling grain is acquired.
5. Although silos of curved corrugated iron sheets are satisfactory and easy to construct, the cost at present prices seems to be higher than pre-cast concrete.

THE LIMITATIONS AND ADVANTAGES OF THE NEW INSECTICIDES

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COST will doubtless be the first limitation to come to the grower's mind when he reads the above title; for it is cost which, with few exceptions, has limited the use of chemical methods of crop protection, except on those of market value per acre high enough to stand the charge. The apple grower whose orchards are afflicted with the usual range of diseases and pests would nowadays incur an annual expenditure of some £30–40 per acre, the cost resting not always on the chemicals used, but on the labour and machinery required for their application. To spray an average fruit plantation using a mobile spray machine operated by a tractor driver and two spraymen, would require about 8 man-hours per acre, per application.

New Methods of Application Naturally the grower is attracted to methods requiring less time and labour. By replacing the manually-operated spray brooms by an array of nozzles fixed to the mobile machine, a method christened "automatic" spraying, this figure can be reduced to about 1½ man-hours per acre. One of the main difficulties of automatic spraying is the rapid provision of water; each application requires some 500 gallons per acre an amount unobtainable in some localities and rendering the operation difficult on soft or rough ground. To avoid this water difficulty, methods are now being examined in which the water is replaced by air. "Air-blast" methods have long been used for the application of dusts. If liquids are to be so applied, they must be broken up into fine droplets, otherwise they would fall too quickly from the air-stream; for this reason the method has received the deceptive name of "atomization".

Problems of "Atomization" There are two major difficulties to be overcome if "atomization" is to be applied successfully for the treatment of relatively small acreages. The first is drift, for not only are the fine droplets carried away by the lightest of breezes, but only the largest of those droplets which do drift through the foliage will be retained by the leaves. The air stream is deflected by the leaf and the fine droplet will be carried with it, unless it is large enough to have the necessary momentum to proceed on a straight-enough path to hit the leaf. An uneven application will follow and the larger droplets will be deposited on foliage near the machine; the finer droplets drift away to fall to earth miles away. Inevitably, if trees remote from the atomizer are to receive an adequate spraying, then those near the atomizer will be oversprayed, which leads to the second difficulty—spray damage.

At first sight it seems ridiculous that it should take 100 gallons of water to apply, in normal spraying, 1 gallon of lime-sulphur or 2 lb. of lead arsenate. But these are the concentrations found necessary to leave enough lime-sulphur or lead arsenate on the leaves to give effective protection from Scab or winter moth, yet not enough to damage the leaf. Over-application is impossible at one spraying, for the excess of spray will run off. But in the atomization of more concentrated sprays the amounts applied are not enough to cause run off, and overspraying with consequent damage is, as has been shown, unavoidable. One way out of this difficulty is to use chemicals which can be over-applied without causing leaf damage. An

important advantage of DDT and some other new insecticides is that they are non-injurious to plants, with the exception of cucurbits, and have solvent properties which permit compounding to safe concentrates or dispersible powders. Over-application will not matter. Active search is now proceeding for safe fungicides to replace lime-sulphur or Bordeaux mixture, for foliage and fruit will tolerate only a small deposit of these older fungicides.

Systemic Insecticides Problems of application become less formidable if the requirement of uniform deposition over the entire plant surface can be avoided. If, for instance, the insecticide could pass into and be carried by, the sap stream, it would be distributed throughout the plant in spite of a patchy application to the ground and lower foliage. Such insecticides have now been discovered, and because they render the whole plant insecticidal they are called "systemic" insecticides. Unfortunately all the compounds so far known which have this property are also highly poisonous to man and stock; some so toxic that they could not be recommended for use in inexperienced hands. But toxicity tests have shown one of these compounds to be reasonably safe; because it has not yet received a name for common use, its chemical name, bis(dimethylamino) phosphonous anhydride, must be used. This compound, when watered in to plants, renders them insecticidal to sap-feeding insects such as aphids. Moreover, it renders toxic the growing point and tissues developing after treatment, and may for this reason prove of particular value for the control of aphid-transmitted virus diseases. If compounds capable of a similar systemic action against fungi could be found, and recent work suggests that such compounds exist, the problems and cost of application are going to be greatly reduced.

Selective Action Plants rendered insecticidal by means of bis(dimethylamino) phosphonous anhydride are relatively non-toxic to pollinating insects and to those which do not feed on the plant sap. Hence the predatory capsids and hover fly larvae remain unharmed, even if they feed on poisoned aphids. The insecticide is selective in action, a great merit, since beneficial insects are unaffected by its use. Correspondingly, a severe limitation of DDT, BHC and parathion is their non-selective action, and care must be taken in their use to ensure that their effect on beneficial insects is held as low as possible. In the early days of DDT indiscriminate use on fruit, for example, was followed by severe attacks of fruit tree red spider mite, for the predatory capsids which help to keep the mite in check had been destroyed. Fortunately, except when codling moth is present, the use on DDT or BHC on apple is unnecessary after the green-cluster stage. Those who complain that modern insecticides destroy one pest to create another, have only themselves to blame, for they should not experiment with new materials until more experienced workers have studied the effects of the insecticide on the general biological environment of the treated crop. But the fact that complaints have been made indicates the need for continuing the search for really foolproof insecticides.

The disadvantages of the non-selective insecticidal properties of DDT and BHC are aggravated by the high stability and persistence of these compounds in soil or in the spray deposit. In many circumstances, as in the eradication of disease-carrying mosquitoes or flies, this stability is of inestimable value. But for agricultural uses it is better, as a general rule, that the insecticide should decompose at a rate which precludes build-up. The continued use of BHC, for example, for wireworm or flea beetle control might lead to accu-

mulation in the soil to such an extent that the biological activity of the soil flora and fauna becomes affected. This defect is particularly serious with the impure BHC now in use, for the mixture contains components, other than the active insecticide, which not only have unwanted biological activity but which impart an objectionable flavour to some food crops. Present-day BHC preparations should therefore not be used on land intended for potatoes, carrots or onions in the same or either of the two following years and, when used, should never be applied in amounts greater than those recommended by the manufacturer. Once economical methods of removing these undesirable impurities from BHC have been found, these limitations will largely disappear.

Smokes Advantage may be taken of the stability of BHC, azobenzene and, to a less extent, DDT for their application by means of "smokes" produced by the low-temperature ignition of special pyrotechnic mixtures containing the insecticide or from thermostatically-controlled electric generators. So simple and effective has this method proved for the fumigation of closed spaces, such as glasshouses and stores, that it has now been applied to less heat-stable compounds. Indeed there are already on the market smoke generators for the application of parathion, for which the method scarcely seems suitable. Parathion, at temperatures not far above the boiling point of water, undergoes a curious chemical change to compounds not only less insecticidal but much more toxic to man than the parent compound. As the ignorant or unwise use of parathion has already caused fatal accidents on the Continent and in the United States, the parathion smoke generator would appear to be far too dangerous and too wasteful to warrant recommendation.

Resistant Strains In the agricultural use of insecticides it is rarely economical or possible to apply concentrations adequate to kill the entire population of an insect pest. It has sometimes been found that the progeny of the survivors inherit the resistant qualities of their parents. Because of this the continuous use of cyanide fumigation for the control of citrus scale insects in California led to the development of a scale population which tolerated the treatment. Similarly, the widespread and continuous use of DDT for fly control has resulted in the selection of DDT-resistant flies in Sardinia and in experimental laboratories. On the whole it is unlikely that, in this country with its scattered acreage of diverse crops, the use of DDT or other persistent insecticide will select resistant strains, but the danger is not to be ignored, especially in glasshouse cultivation. The safeguard is to find a second insecticide to which the resistant individuals are susceptible and then to "ring the changes." For example, the DDT-resistant flies are susceptible to chlordan, which is now being used, alongside DDT, for fly eradication in Sardinia. Similarly for red spider mite control in glasshouses, the azobenzene smoke should occasionally be replaced by a derris-wetter or other acaricidal spray.

An interesting point arises: would it not be better to apply the two contrasting insecticides simultaneously? It has been shown, theoretically, that if two insecticides A and B are such that those insects of a particular species most resistant to A are those most susceptible to B and vice versa, then a complete kill could be obtained much more economically by the mixture of A and B than by the use of either A or B alone. Suppose that sprays containing 145 parts of A or 60 parts of B, where used separately killed 99 per cent of the sprayed insects, then a complete kill would be given by a mixed spray containing 10 parts of A and 10 parts of B. Unfortunately no

pair of compounds A and B has yet been found with the completely contrasted insecticidal properties required for this calculation to be checked by practical trial, but the example is quoted to show the attractive possibilities opened up. The study of combined insecticides is certain to be an important future line of research in the attempt to extend the usefulness and to reduce the limitations of present-day insecticides.

Summary To sum up, among the advantages claimed for the new insecticides are: a far greater insecticidal potency and, in the case of DDT, BHC and other chlorinated compounds such as chlordan (not yet widely used in this country), a stability which gives spray deposits of long-lasting toxicity to insects; a safety to foliage which permits the development of methods of application ("atomization" and "smoke") cheaper in man-hours than the spraying methods necessary for the older and phytotoxic insecticides; a diversity of insecticidal action which opens up attractive possibilities in the development of combined insecticides.

But the new insecticides are not foolproof, and limitations to their use arise:

in the case of DDT, BHC and parathion—their unwanted effect on beneficial insects if applied at the wrong time; the danger that extensive or continuous use may lead to the selection of resistant strains;

in the case of DDT and BHC—the risk of accumulation in the soil to an extent which may have undesirable reactions on soil organisms or, with BHC, of compounds imparting taint to certain root crops. Finally, the poisonous properties of parathion and the systemic bis(dimethylamino) phosphonous anhydride render their use hazardous, a special point being the heat-instability of parathion.

PICK-UP BALERS FOR HAYMAKING

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THE increased prices of all concentrated feedingstuffs, and the fact that artificially dried grass sells at £25–£30 a ton, combine to emphasize the importance, both to the country and to the individual farmer, of improving the quality of hay. With many farming operations—ploughing, for example—the main object of mechanization is to enable a few men to get the job done cheaply and within a reasonable time; and the yardsticks "man-hours per acre" and "cost per acre" together give a good indication of the success or otherwise of the methods used. In haymaking, on the other hand, while "man-hours per ton" may be important as the measure of what a limited labour force can do, it is of little consequence when compared with the effect of the methods used on the quality of the product. Really good hay can be equivalent in feeding value to the lower grades of dried grass, and though its market value may be limited, its value for home consumption may be up to £20 a ton. At the other extreme, very bad hay may be worthless, apart from some small value as a source of manure. It is apparent, therefore, that the cost of making and collecting the hay, which will seldom exceed £5 a ton, is relatively unimportant, and that it is those factors which determine the quality of the product which should receive most attention in any study of haymaking mechanization.

PICK-UP BALERS FOR HAYMAKING

Whatever the method of haymaking, speed in completing the necessary parts of the process when the time is ripe is probably the most important consideration in making good hay. This applies just as much to the farm in an unfavourable climate, where the hay is laboriously put into cocks or on to tripods, as it does to the more favoured regions where the pick-up baler does the job; and it applies to every stage of the work, from cutting to storing the hay safely under cover. In this respect the modern self-tying pick-up baler is an excellent machine, for in suitable conditions even the smaller types can give "net" working speeds of up to 5 tons per hour, and can average 3 tons per hour overall. Moreover, the baling operation itself is fully automatic, and quite satisfactory work can be done by a tractor driver working alone, though it is often convenient to employ a second man to assist in seeing that there are no "misses" and that the bales are dropped in windrows.

Provided care and good judgment are exercised, hay made by pick-up baler can be as good as that made in the stack.

Hand-tying Ram-type Machines Pick-up balers of the wire-tying ram type, which require two operators in addition to the tractor driver, must now be regarded as obsolete, though they are still useful machines, particularly where the hay is to be sold and transported long distances. With these machines, quite apart from the extra cost for labour, there is the disadvantage of a low rate of work. The maximum rate that experienced operators can maintain with such machines is about one bale a minute, and output is usually not more than 2 tons per hour with the smaller machines which have a baling chamber 14 inches by 18 inches in section, or 3 tons per hour with the large machines which have a baling chamber 22 inches by 18 inches. Some of these machines can be converted to string-tying by hand methods, but the advantages of such a conversion are doubtful. The conversion, where efficient, can save one operator, but the speed of work is still restricted, while the cost of the heavy twine needed is a little more than that of wire. Nevertheless, many farmers greatly dislike baling wire, owing to the harm that can be done by cattle swallowing short pieces, and some prefer twine tying if only for this reason.

Self-tying Balers Mention may be made of the following types of automatic or self-tying pick-up balers:

1. *Press Type*. The press baler is the type commonly found on the Continent, particularly in Germany and Denmark. The bale is compressed along its long side (bale chamber section 12 inches by about 40 inches), and the tying is done automatically by two knotting mechanisms which work exactly like those of a binder. The bales are apt to be rather loose and untidy, and will not stand rough handling; but they have the advantage that handling with a hay-fork is easy, the weight being usually only about 20–30 lb. These machines are equipped with a wooden ramp, at the rear of the press, which delivers the bales directly on to a four-wheeled trailer (see Fig. 1). This arrangement makes it a simple matter on level land for two men to pick up from the windrow, bale and load in one operation. The rate of work is usually rather low—about 2 tons per hour. Prices are around £500–£700.

2. *Ram Type with Automatic Twine Tying*. This popular type of machine (as shown in Fig. 2) makes a compact bale with a section usually about 18 inches by 16 inches, and length variable from about 30 to 40 inches. The bales are automatically tied lengthwise with medium weight twine, having a "runnage" of about 225 feet to the pound. Bale density can be varied

easily, but in general the bales are not quite as tight and "square" as those from a hand-wired machine. The plunger which pushes hay into the baling chamber carries a knife which slices the hay, making the layers very easy to separate for feeding. Prices range from around £500 for a small P.T.O.-driven machine, up to about £1,000 for a large capacity engine-driven model. About 5 lb. of twine is used per ton of hay, at a cost of about 6s. 8d. Automatic wire-tying ram-type balers are available in the United States, Canada and parts of Europe, but not at present in Britain.

3. ***Roll-type Roto-Baler*** The roll-type pick-up baler (see Fig. 3) picks up the hay from the windrow and rolls it into cylinders 36 inches long. The density of the bales can also be adjusted readily, and if the windrows are well prepared, there is no difficulty in making really tight bales with most crops. The bales are not tied, but they have an average of about 30–36 feet of binder twine wound spirally around them. At this rate, a ball of binder twine ties about 120 bales, and at a cost for twine of £7 a cwt. (12 balls), the cost of twine with bales averaging about 60 lb. each, is around 4s. a ton of hay.

The roto-baler is a fairly cheap machine, and farmers' experiences with it have been satisfactory. When once the rather tricky mechanisms are understood, setting and adjustment are easy, and there is little to go wrong. As with other pick-up balers, it is important, however, that the operator should understand the machine before attempting to use it.

P.T.O. or Engine Drive The choice of a P.T.O.-driven or engine-driven pick-up baler must depend on the tractor power available, or on the contour of the land. As with many other machines of this kind, independent engine-drive gives the best performance; but with most pick-up balers, P.T.O.-drive is satisfactory, provided the tractor is capable of delivering about 30 B.H.P. or more. A tractor with a good range of gears is naturally an advantage. Some of the smaller balers can be satisfactorily driven on level land by tractors delivering only 20–25 B.H.P., but this is usually insufficient. With the "Roto-baler," the tractor has to stop its forward motion every time a bale is ejected. This involves a good deal of tedious declutching and gear-shifting with the P.T.O.-driven machine, and some of this is eliminated if a tractor with a "free P.T.O." is employed. Nevertheless, the job can be done quite well with an ordinary 25–30 h.p. tractor, equipped with the usual kind of power-take-off. In general, P.T.O.-drive ought to be good enough for pick-up baling on most farms, and there is less need for an independent engine than there is with such machines as combine harvesters and potato harvesters.

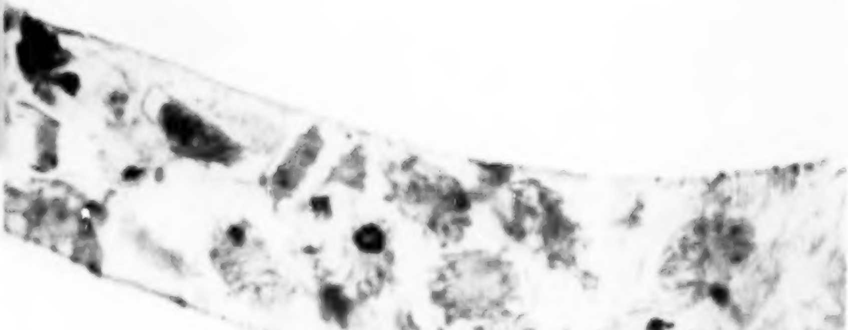
When to Bale Hay is now generally considered to be fit to bale only a very little earlier than when it is fit to stack, and though very good green hay of high feeding value can sometimes be made by early baling, the risks are great and the temptation to start before the crop is reasonably fit should be avoided. Hay that is fit to stack usually has a moisture content of about 20–25 per cent. With pick-up baling, it is sometimes possible to get good results with material having a moisture content of up to about 30 per cent, provided the windrows are uniformly dried and that fairly loose bales are made so that drying can continue in the bale. But with very damp green hay there is always a possibility that serious moulding may result, and the bales must be left out for a time or stacked so that air can pass through them to avoid heating. The tougher the hay when baled, the looser the bales

1. Press type, self-tying pick-up baler, showing delivery of bales to trailer

Photos. N.I.A.E.

2. P.T.O.-driven ram-type pick-up baler with automatic twine tying.

Thoracic tracheal system of a bee. Badly stained tracheae show the presence of acarine disease



Part of a diseased trachea. Mites in various stages of development can be seen.

INE DISEASE (See p.p. 35-8)

Thoracic tracheal system of a healthy bee.

Sulphur cartridges with the type of smoker most suitable for sulphur smoke treatment.

Heavy sulphurous smoke being blown into a hive.

3. P.T.O.-driven roll-type pick-up baler.

Photos: N.I.A.E.

4. Home-made bale sledge in operation.

should be, a suitable density for very damp hay being 8–10 lb. per cubic foot. Damp patches in the windrows will cause trouble with mould. Hay should never be baled when there is surface moisture on it, since this is almost certain to result in a mouldy product. On the other hand, the crop should not be allowed to get over-dry, since this will result in the loss of a very high proportion of the leaf through shattering, and will inevitably produce a fodder of low feeding value.

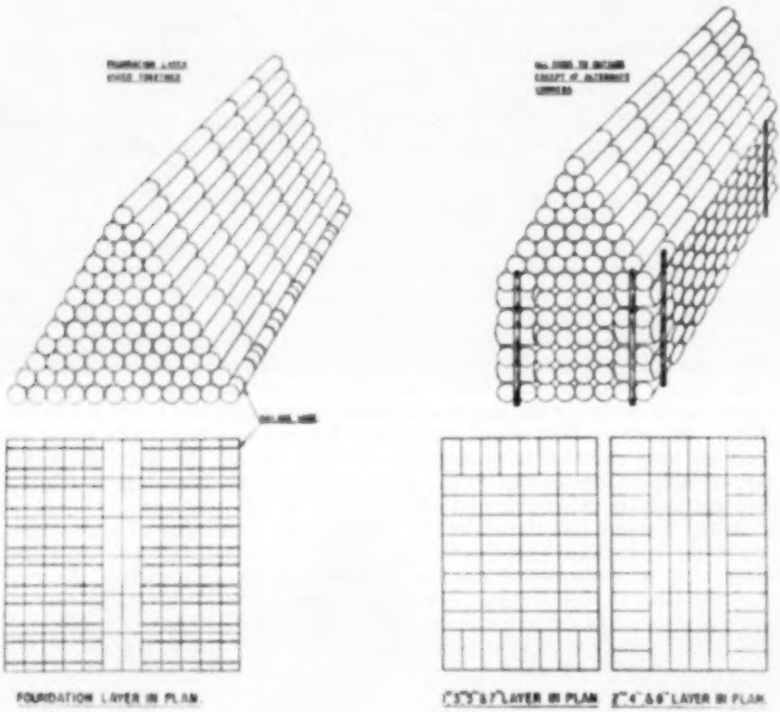
In using swath-turners and later preparing the windrows, the aim should be to hasten the drying process as much as the weather permits, and to finish with rows which are straight and uniform in both thickness and fitness. Most pick-up balers do best with fairly small windrows, which pass easily over the pick-up and into the baling chamber, and it is not worth while to produce big windrows and run the risk of blockages. With the "Roto-baler," on the other hand, it is necessary to make thick rows of uniform width and height, though these must not be wider than the pick-up.

Collecting the Bales A great deal of controversy has raged during the last few seasons on the subject whether it is better to cart the bales immediately, or to leave them in the field to dry out. The answer to this question depends both on the condition of the hay when baled, and on the type of baler used, as well as on weather conditions. If the hay is baled in perfect condition it seems foolish to leave it out in the field to get bleached on the outside, to get wet if it rains, and to require moving every few days to avoid mould at the bottom or spoiling the grass on which the bale stands. On the other hand, there is no doubt that in average weather appreciable drying of the hay takes place if damp baled hay is left out in the field. Moreover, both rolled bales lying flat and ram-type bales stood on end are very resistant to damage by showers, though the latter do suffer appreciably in continuous rain. Bales produced by press-type machines are particularly vulnerable and should never be left out.

Many farmers find the collection of the bales something of a problem, since the specialized bale-loaders are not yet fully satisfactory, while the extra cost of a specialized machine can often hardly be justified. Several farmers have tackled this problem by attaching a bale sledge to the rear of the baler in such a manner that the bales can be dropped in windrows. Fig. 4 shows a typical home-made sledge designed for carrying about nine bales. It is made very simply out of a pair of heavy gauge corrugated iron sheets. The bales are collected and carried on the sledge until the windrow is reached, where they are pushed off without stopping. If desired they may be shipped off by sticking a bar into the ground through a slot designed for this purpose. Subsequently, it is a simple matter to come along the thick windrows with the transport, and collect the bales without much running about. A "universal" sack, bale and root-loader can be efficiently used when the bales are grouped in this manner.

Stacking There can be no doubt that the best place to stack baled hay is in a barn, and that the earlier fit hay is there, the better. A great deal of baled hay is spoiled by bad stacking, and even if great care is taken with the stacking, the bales often move so much on settling, that what appeared to be a good stack becomes an untidy heap which is easily damaged by rain. Wire-tied bales should be stacked on their narrow sides with gaps of 3–4 inches between the rows if they are taken in at once; but if the bales are really dry, or with string-tied bales, there is usually no need to make any special provision for ventilation. The stacking of roll-type bales in rec-

tangular stacks presents some difficulty. On an open site, the easiest method is to stack in a pyramid, as with drain-pipes; a base 12 bales wide often gives a suitable size. All that is necessary to prevent slipping is to pass baling wires round the 4 or 5 outer bales at both ends of the bottom layer. Some farmers favour rectangular stacks, and build with all bale ends to the outside, except at alternate corners. Such stacks, however, need great care in building, unless they are in a barn and can receive a little support from the walls.



METHODS OF STACKING CYLINDRICAL BALES.

Warble Fly

The Warble Fly (Dressing of Cattle) Order of 1948 requires stockowners and persons in charge of cattle to dress all cattle visibly infested with the maggots of the warble fly with derris at monthly intervals from March 15 to June 30.

The destruction of warble maggots is a measure of good husbandry. By carrying out the provisions of the Order farmers will kill the maggots which produce the warble fly and so help to reduce year by year the amount of damage caused by warbles. Particular attention should be paid to outlying stock.

Copies of the Order and the Ministry's advisory leaflet about the warble fly may be obtained from Animal Health Division, Ministry of Agriculture and Fisheries, 28-32 Chester Terrace, London, N.W.1.

THE PEACH IN ENGLAND

1. HISTORICAL

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Ministry of Agriculture and Fisheries

DURING the present century the commercial status of the peach has risen very considerably. Probably the peach can now be placed third in the world's list of deciduous fruits, first and second places being occupied by the apple and pear respectively. This ranking gives the peach first place in the list of stone fruits, preceding the plum and cherry. The reason for the peach's ascendency is not far to seek; for in addition to its popularity as a dessert fruit, it has high commercial value for canning, jam-making and drying. Admittedly the peach is one of the most attractive and luscious of all succulent fruits.

A Garden-Nurtured Fruit In England, until recently, the peach had never been taken up as a commercial orchard fruit, though it has been grown commercially in the form of specially trained trees under glass and on walls. To a considerable extent the peach has been a domestic fruit, grown mainly in large private gardens where walls, peach "racks" and glasshouses could be provided for its culture.

The reason for this limitation was, probably, a belief that the peach was unsuitable for normal orchard culture in the English climate; for although the tree is hardy, the English climate on the whole is not very favourable to growth and blossoming in the spring. With the peach, however, it is not so much the blossom as the growth that may suffer under the vagaries of the English climate. Warm spells in early spring tend to start the trees into growth, and a series of late frosts can either kill or damage the new growth while it is tender. When the trees are grown against a wall this damage is not likely to be so severe and indeed can be prevented by draping the trees with netting; on the other hand, bushes and standards in the open must take their chance of climatic injury. The blossoming time of the peach is, as a rule, early April, but the flowers break over a comparatively long period and the blossom clusters afford protection to the inner flowers. Consequently the blossom does not suffer the wholesale damage that plums do under similar conditions.

Moreover the peach is self-fruitful and its culture is not beset with the pollination difficulties that some kinds of plums experience. Pollen has to get only from stamens to stigma on each flower, and not from tree to tree as with self-incompatible fruits. Usually, unless the blossom is very severely damaged by frost, fruit setting is free, and in fact drastic thinning is necessary to obtain fruits of fair size.

The peach is a fruit of great antiquity. It is believed to have originated in China and to have come westward via Persia over the old trade routes, first to Greece and thence to Rome. From Rome, it spread all over Europe. There are grounds for the belief that the peach has been in England since very early times. In old works the name is spelt *peske*, *peesk*, *peshe* and *peche*, names that seem to indicate early association with the Roman *persica*. Probably the peach arrived in England from the Mediterranean region during the early historical period when, also, the apple, cherry, apricot, plum, damson, grape, walnut and filbert arrived.

The nectarine, long associated with the peach, is not a distinct fruit but a kind of peach (*Prunus persica*) that is, a smooth-skinned peach. Genetical proof of this has been given by Crane and Lawrence(1). Downy skin and smooth skin in the peach constitute a pair of allelomorphic (alternative) characters, the former being dominant and the latter recessive; both characters segregate according to known Mendelian laws. Thomas Rivers (1866) stated that he had raised a peach tree from a nectarine stone(2).

Raising Trees The peach is a diploid species with sixteen chromosomes in the somatic cells; tetraploids have, however, occurred under artificial stimulation (colchicine treatment). No instance of pollen incompatibility is known to occur, but there are instances of male sterility; for example, in the variety J. H. Hale. Female sterility does not occur. Generally speaking, the peach sets its fruit freely and crops prolifically.

The seedlings of a given variety of peach are not so variable as those of most other deciduous fruits. The basis of this is entirely genetical, for polyembryony* is not known to occur in this species. In consequence, trees that bear useful fruit are quite commonly raised from peach stones, though of course they may not closely resemble the parent tree. In a paper read at the International Horticultural Congress in 1866(2), Thomas Rivers stated: "I sowed stones of the *Noblesse* peach, and planted the young trees they produced against a wall; in the course of eight or ten years they all bore fruit; *all were so like their parent as not to be distinguishable from it*" (writer's italics).

Full advantage of this method of raising peach trees was taken by the earlier civilizations, and notably in recent times by the first European settlers to North America. Even as late as the nineteenth century it was customary, according to Browne(3), to establish orchards in New England by planting peach stones along with corn (maize) so that when that crop was harvested the young peach trees were left in occupation of the land.

In England it is not unusual to hear of peach trees flourishing and fruiting regularly in the open; often the origin of such trees were stones saved from purchased fruits and sown in the open ground or in flower pots. For instance, in 1947 information was received about a number of trees growing in the Greater London area. One of these (inspected by the writer) was growing at Charlton, S.E. London, was twenty-three years old and had borne upwards of 1,000 peaches of excellent quality every season since it had come to full development. This tree was raised from a stone.

However, as with other deciduous fruits, vegetative propagation is the only reliable method of perpetuating a given clonal variety of the peach, and budding is the normal practice. Naturally, with a fruit that has been in cultivation so long and so universally, there are a great many varieties of peach. For example, in its publication, *The Cherries of New York*, the New York State Experimental Station listed over 2,000 varieties grown in North America. In England peaches come under extended notice by writers of the sixteenth century. Shakespeare's contemporary, John Gerard (1545–1607), stated in his *Herball*(4): "There are divers sorts of peaches," and explains that there are red, yellow and white fleshed peaches. He then gives the names of 12 peaches and 6 nectarines.

Nearly a century later, John Evelyn, in his *Sylva* (4th Ed. 1678) names 7 peaches fit for use in July, 14 peaches and 6 nectarines for August, and 4 for September; in all he mentions 21 kinds of peach and nectarine suitable for growing in English gardens(5).

* Term applied to seeds which contain several embryos, only one or possibly none of which is the result of fertilization, the others arising from cells outside the embryo sac and being thus a form of vegetative seedling.

Ninety years later Thomas Hitt, in his *A Treatise of Fruit Trees* (1768), described 20 kinds of peach and 7 nectarines which gave a fruiting season of about three months(6). It is of interest to note that Hitt's list included several varieties, Noblesse, Royal George, Violette Hâtive, and Bellegarde which were listed by Edward Bunyard over 150 years later as being cultivated in England. Bunyard, one of our best authorities on fruit varieties, in 1925 described 59 distinct kinds of peach and 23 nectarines commonly grown in England(7).

Indebtedness to the Rivers Family Much of the credit for the development of the peach in England must go to the Rivers family, of Sawbridgeworth, Hertfordshire, who established the famous nursery at that place, now the oldest fruit-tree nursery in England. A member of the fourth generation of this family, Thomas Rivers (1770-1844), travelled extensively on the Continent and studied fruit-growing practices there. He introduced a number of new varieties of fruits into this country and laid the groundwork of his later successes with plums, pears, peaches and nectarines. His son, Thomas Rivers (1797–1877), and grandson, T. Francis Rivers (1830–1899), carried on the work and themselves raised many new varieties besides introducing some from North America. Especially they had success in extending the season of peaches and nectarines and raising and introducing varieties more suited to the English climate. Two varieties, Early Rivers and Salwey, were the only English varieties of peach ever grown extensively in North America.

The success attending the efforts of the Rivers family in developing the peach, was revealed by Hogg who, in his *Fruit Manual* (4th Ed. 1875), lists some 100 varieties of peach and 35 of nectarines grown in England during the latter half of the last century. Of these, 24 peaches and 13 nectarines were raised at Sawbridgeworth.

Concentration on more important food crops during the 1939–45 war resulted in a drastic reduction in the number of peach varieties available for propagation, since it was impossible for nurseries to keep all stock trees in existence. At the present time about 40 varieties of peach and nectarine suitable for cultivation in England are kept in propagation. The writer is indebted to Messrs. Thomas Rivers and Son, Ltd., for the descriptions of these varieties (pp. 30–32).

It will be of interest to mention, by way of concluding this historical description of peach culture in England, that most of the popular North American varieties have proved disappointing under English conditions. The exceptions are Alexander, Rochester, Amsden June, Hales Early and Waterloo. This fact and the fact (alluded to above) that very few English varieties have been successful in North America, serve to indicate the importance of developing varieties of fruits, not only of the peach, suited to the special conditions of soil and climate prevailing in the British Isles.

The writer is indebted to Mr. T. H. Rivers, of Sawbridgeworth, for information regarding the Rivers family.

Part 2 of this article will deal with the cultivation of the peach in England.

References

1. Crane, M. B., and Lawrence, W. J. C. *Genetics of Garden Plants* (3rd Ed.) 1947.
2. Rivers, Thomas. *On Raising Peaches, Nectarines and Other Fruits from Seed.* Report of the International Horticultural Exhibition and Botanical Congress, 1866.
3. Browne, D. J. *The Trees of America*, 1846.
4. Gerarde, John. *The Herball* or *General Historie of Plantes*, 1597.
5. Evelyn, John. *Sylva.* (4th Ed.) 1678.
6. Hitt, Thomas. *A Treatise of Fruit Trees* (3rd Ed.) 1768.
7. Bunyard, Edward A. *A Handbook of Hardy Fruits*, **2**, 1925.
8. deCandolle, Alphonse. *Origin of Cultivated Plants*, 1884.

VARIETIES OF PEACHES AND NECTARINES GROWN IN ENGLAND

(*Note* : Those suitable for outdoor culture are marked *)

PEACHES

***Alexander**
Small to medium size, ripening mid-July. Creamy white with dark red flush and mottling. Flesh white, firm, clinging to stone. Flavour fairly good. An American peach introduced by Rivers in 1876.

Alexandra Noblesse
Large, ripening early September. Colour greenish white with slight flush. Flesh yellowish white. Flavour excellent but does not set well enough for market use. Raised by Rivers in 1867.

***Amsden June**
Similar to Alexander except for darker red and slightly better flavour. Introduced from America about the same time as *Alexander*.

***Crimson Galande**
Fairly large, mid-August. Colour pale green to golden yellow with rich crimson flush. Flesh greenish white, red near stone. Very good rich flavour. Raised by Rivers and introduced in 1866.

***Dagmar**
Medium size, early August. Pale yellow with crimson flush. Flesh pale yellow, free stone. Flavour very good. Raised by Rivers and introduced in 1863.

***Duke of York**
Large, mid-July. Colour rich crimson. Flesh greenish yellow. Free stone. Flavour very good. Excellent for forcing or for outdoors. Raised by Rivers and introduced in 1902.

***Dymond**
Large, early Sept. Colour pale yellow with deep red flush and mottling. Flesh pale yellow red at stone. Rich flavour. Raised by Messrs. Veitch about 1860.

Magdala
Medium, mid-August. Creamy white, crimson on exposed side and nearly smooth. Flesh white. Flavour good. Raised by Rivers in 1865.

Nectarine Peach
Large, mid-Sept. Colour dull yellow with dark red flush. Flesh greenish yellow, slight red at stone. Skin fairly smooth, hence its name. Flavour good. Raised by Rivers in 1864.

***Peregrine**
Fairly large, early August. Colour bright crimson red. Flesh yellowish white. Flavour very good and juicy. The best all-round peach, hardy and fertile. Raised by Rivers in 1904.

Prince of Wales
Large, mid-Sept. Colour yellow with crimson flush and stripes and white spots. Flesh yellow, red at stone. Flavour good. Fertile. Raised by Rivers in 1871.

Princess of Wales
Large, end Sept. Pale yellow with faint red stripes. Flesh pale yellow. Flavour very good, better than Prince of Wales but less fertile. Raised by Rivers in 1872.

***Royal George**
Large, early Sept. Pale yellow with deep red cheek. Flesh pale yellow, red near stone. Rich flavour. An old variety.

Sea Eagle
Very large, end Sept. Colour lemon-yellow with deep mottled crimson flush. Flesh pale yellow, red at stone. Free stone. Flavour good when well ripened. Vigorous and hardy. Fertile. Raised by Rivers in 1881.

Thomas Rivers
Large, end Sept. Pale yellow with crimson mottling. Flesh whitish with red at stone. Free stone. Forces well. Raised by Rivers in 1898.

***Waterloo**
Small to medium, mid-July. Pale yellow, crimson red flush. Flesh greenish-white. Flavour very good. An American peach introduced in 1877 or 1878.

Also grown in small numbers:

Duchess of Cornwall
Medium to large, mid July. Light yellow with red flush and stripes. Flesh white. Flavour good. Raised by Rivers in 1897 as *Duchess of York*. Good for forcing.

***Early Rivers**
Fairly large, mid-July. Colour lemon-yellow with slight flush of faint stripes. Flesh white. Good flavour with some trace of nectarine. Rather tender for market. Raised by Rivers in 1864.

Early Silver
Large, mid-August. Pale yellow with light red flush and dark red dots. Flesh white. Free stone. Flavour excellent but rather a tender fruit. Raised by Rivers in 1859.

English Galande (Violette Hâtive)
Large, mid-Sept. Primrose-yellow with dark red flush on sunny side. Flesh pale yellow, red at stone. Excellent flavour. An old variety, origin unknown.

Gladstone
Large, end Sept. Colour greenish-yellow with slight flush and mottling. Flesh white, free stone. One of the best flavoured late sorts. Raised by Rivers in 1880.

Golden Eagle
Large, early Oct. Golden-yellow with carmine flush. Flesh golden-yellow. Flavour excellent. Raised by Rivers in 1883.

***Goshawk**
Large, early Sept. Pale with brown red flush and mottling. Flesh pale. Flavour rich and good. Raised by Rivers in 1878.

***Hale's Early**
Medium, end July/early August. Lemon-yellow with crimson flush. Flesh very pale yellow. Free stone. Flavour fair. Very hardy and fertile. American origin introduced to England in 1876.

***H. S. Rivers**
Medium, end August. Colour cream with red flush nearly all over. Flesh white. Flavour excellent. Introduced by Rivers in 1937.

***Kestrel**
Large, early August. Colour rich crimson. Flesh pale yellow, a little stringy. Flavour good rich and sweet. Raised by Rivers in 1911.

Lady Palmerston
Large, October. Colour golden -yellow with brown red flush and mottling. Flesh deep golden yellow, firm, slightly red at stone. Flavour good. Raised by Rivers in 1869.

***Libra**
Large, August. Creamy-yellow with crimson flush. Flesh pale yellow. Good flavour. Hardy and prolific.

Salwey
Medium, end Sept. Colour yellowish-green, faint flush. Flesh orange. Flavour good, perfumed. Introduced about 1850 by Messrs. Turner of Slough.

NECTARINES

Cardinal
Medium, mid-July. Brilliant scarlet on yellow ground. Flesh white. Flavour excellent. Clingstone. Fertile. Good for forcing, not hardy. Raised by Rivers in 1897.

Darwin
Large, Sept. Deep orange with dark red flush. Flesh orange. Flavour very good. Free stone. Raised by Rivers in 1871.

***Early Rivers**
Large, end July. Greenish-yellow with almost complete scarlet flush and stripes. Flesh green. Flavour very good and rich. Free stone. Raised by Rivers in 1893. Forces very well and is hardy.

Humboldt
Large, Sept. Colour orange with deep crimson flush and mottling. Flesh yellow, red at stone. Flavour rich and good. Very handsome flowers. Raised by Rivers in 1876.

John Rivers
Large, mid-July. Highly coloured. Excellent flavour. Good for open but does not force. Raised by Rivers in 1924.

Lord Napier
Large, early Aug. Pale yellow with deep crimson over it. Flesh pale green. Flavour very good. Fertile. Raised by Rivers in 1869.

Pineapple
Medium to large. Early Sept. Crimson-red on yellow ground. Flesh golden with slight red at stone. Flavour very good. Raised by Rivers in 1870.

Rivers Orange
Medium, early Sept. Golden-yellow with dark red flush. Flesh deep yellow red at stone. Flavour good and perfumed. Vigorous and fertile. Raised by Rivers in 1886.

Spencer
Very large, end Sept. Pale green with dark red flush nearly all over. Flesh pale green and red at stone. Flavour excellent. Free stone. Raised by Rivers in 1872.

***Stanwick Elruge**
Large, early Sept. Pale green with purplish-red flush on sunny side. Flesh greenish white, red at stone. Excellent, slightly acid flavour. Raised by Rivers in 1878.

Victoria
Medium to large, end Sept. Pale with red flush darker on sunny side. Flesh white, red at stone. Flavour rich and sweet. Free stone. Raised by Rivers in 1861.

***Violette Hâtive**
Small, mid-August, pale yellow with rich crimson flush and mottling. Flesh white, slight red near stone. Flavour very good. Fertile. A very old nectarine from France.

RECENT CHANGES IN HORTICULTURAL CROPPING

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IN these days when many growers keep accurate records of output and costs, and statistics and price returns are published regularly in official and trade papers, it is difficult to realize that in the early years of this century no information existed to show the area, production or value of horticultural crops. And though it is true that figures alone can never give a precise picture of an industry which is liable to wide fluctuations from season to season, it is also true that only figures can give any indication of cropping over the country as a whole. In this way they can help growers in preparing plans for the future, particularly in the case of the more permanent types of crops.

Although horticultural statistics may be too young yet to have acquired that infallibility supposed to go with middle age, they have now been published over a sufficiently long period to enable comparisons to be made, based on averages over periods of years. In this way the extremes of good and bad seasons may be levelled out and reliable indications of developments and of trends in production may be obtained. Always, however, it must be remembered that figures of acreage and production cannot disclose the quality of the produce any more than the most carefully compiled market returns can show what proportion of the total supplies makes the highest or the lowest price. And if the figures seem to call for an increase here or a decrease there, it will always be necessary, in addition, to make some estimate of the quality of existing production, of demand and of supplies from other sources. It is of little use to set about increasing output if much of that increase is unlikely to be of a quality high enough to interest the market.

RECENT CHANGES IN HORTICULTURAL CROPPING

Fruit The estimates of production which were first obtained in 1923 and have now been published up to 1945 should be read with the periodical *Censuses*, of which the last was in 1944. Average annual production of top fruit over the ten years 1926–35 was 359,000 tons. Over the five years 1936–40 it was 460,000 tons; and for 1941–45, 491,000 tons. During these last two periods the output of apples increased by approximately 10 per cent and pears and cherries by 35 per cent. Only plums and cider fruit showed a small decline. And although the total acreage varied slightly from year to year, the area remained round about 260,000 acres for the whole period.

The censuses of 1925, 1931, 1936 and 1944 show that in addition to rising yields, other changes were taking place. In twenty years the total number of trees rose by nearly three million, of which roughly two-thirds were planted between 1931 and 1936, the area increasing most noticeably in the Eastern and South-Eastern counties, remaining fairly constant in the Midlands and declining in the West Country. In 1944 a little over 10 per cent of our cooking apples, 15 per cent of the plums and cherries, 30 per cent of the pears and nearly 50 per cent of the dessert apples were under nine years old. The total prbportion of all trees under nine years old was approximately 27 per cent. Cox's led the field with roughly three million young trees to one-and-a-half million older ones. Conference pears had just over ¾ million against ½ million, Worcesters ½ million against 1 million and Victoria plums ¾ million against 1 million. All groups of other plums, cooking apples, cider fruit and cherries had comparatively small proportions of young trees, and while it is clear that, five years ago, there was room for planting selected varieties of these types, it will not be possible to do more than guess how far post-war planting has made good the apparent deficiencies until the next census is taken. Nor shall we know how all the young trees of 1944 have been behaving until the estimates of production for the five years 1946 to 1949 can be published. They will, of course, be high, because the period embraces one, and possibly two, record crops.

There is a different story to tell in respect of soft fruit. Large areas, approaching the 80,000 acres mark, were common forty-odd years ago when these statistics were first collected. Decline set in after the first World War, the area falling to 62,000 acres in 1931 and to 47,000 acres in 1939. By 1945 it was down to less than 30,000 acres. Since then there has been a great revival, and the 1949 figure is 49,000 acres. Strawberries, with 20,000 acres, have doubled their area in six years and are not far below the high acreages of the early years of the century, but the Registers of Certified Stocks published since the end of the war show that a large proportion of this area cannot be devoted to the best varieties.

Black currants, at more than 15,000 acres, represent a record figure, and since the area remained fairly steady at 8,000–9,000 acres between the years 1943 and 1946, the greater proportion must now be of young bushes either coming into full bearing or not yet fruiting.

Red currants, raspberries, loganberries and others, although increasing, are still below the areas common before 1939.

Estimates of production of soft fruit give an average annual output of 54,000 tons over the period 1936–40, and of 42,000 tons for the years 1941–45. But since the total acreage had then fallen by some 30 per cent, it may be seen that yield per acre had been slightly though significantly increased. Estimates for the past four years will undoubtedly show further increases in total and very probably too, in yield per acre.

Vegetables There are many obvious difficulties in estimating the areas and yields of outdoor vegetables, but the figures published about a year ago enable the averages of the three years 1936–37 to 1938–39 to be compared with those of 1945–46 to 1947–48. Excluding potatoes and peas harvested dry, the pre-war figures give an average "cropped" area for the United Kingdom of 343,000 acres, with a production of some 2½ million tons. The comparable post-war figures are 458,000 acres and 2¾ million tons, showing that an increase in area of approximately 33 per cent gave an increase in yield of 22 per cent. The difference in the percentages is due largely, if not wholly, to the unprecedented winter of 1946–47, which affected yields over two cropping seasons.

The main increases in areas occurred in carrots and peas for canning (roughly 100 per cent) lettuce, cabbage and cauliflower (40 per cent) and sprouts (20 per cent), with spectacular rises in the comparatively small areas of outdoor tomatoes and onions. In 1948 there was a further small increase in the total area, but in 1949 there was a fall of nearly 50,000 acres in England and Wales alone. This decrease was spread fairly evenly over all crops, so that those which increased most rapidly during the war are still very near the levels mentioned above. Only broad and runner beans, green peas for market, asparagus and celery are below the former average levels.

Crops under Glass Details of glasshouse production during the early years of the century do not exist, although the censuses give some indication by estimating the value of the different groups of crops. Between 1935 and 1939 more information became available, but its use for comparative purposes is limited because, in the years that followed, cropping was regulated and the acreage of glass varied from year to year. Large areas were destroyed or put out of use, and other areas, on private estates or municipal lands previously used for growing ornamental plants, were turned over to food production.

Since the introduction of the special Glasshouse Returns, more complete information has been available. The total area of glass in 1945 was 4,150 acres, of which nearly 300 acres were covered by frames and cloches. In 1949 the total was 4,767 acres, including 500 acres of frames, etc.

In 1945 permanent flower crops (including orchids) had been reduced to some 64 acres, with 35 acres devoted to other types of flowers. By 1949 these areas had risen to 166 acres and 145 acres, the principal increases being in carnations (from 28 acres to 99) and roses (from 20 acres to 55). Unfortunately it is not possible to say how these increases compare with pre-war areas.

Cucumbers rose from 71 to 383 acres (roughly 100 acres more than the estimated pre-war area) and, though tomatoes fell from 3,465 to 3,313 acres they were still some 1,500 acres above the estimated pre-war level.

Comparison of the production of glass-grown vegetable crops shows that, over the United Kingdom, the combined yield per acre has fallen. The pre-war "cropped" acreage was estimated at 3,100 acres, with an average output of 94,000 tons or approximately 30 tons per acre; whereas the average for the three post-war years is estimated at 24 tons per acre. This is caused by a lower estimate of the yield of tomatoes (31 tons, as against 38 tons) and is probably due to fuel restrictions and the use of unsuitable houses originally designed for other crops. The more recent indications are that with the return of these houses to the production of flowers and cucumbers, the yield per acre of tomatoes is returning to its former level. This means that although the acreage may have fallen slightly, total production is unlikely to decrease in similar proportion.

Conclusion Remembering that information is more accurate and more complete now than it was ten or more years ago, the safest and most reliable figures can probably be obtained by comparing total acreages and gross outputs. In this way possible differences in the various sub-sections tend to even themselves out.

Though the periods for which figures have been published are not exactly the same in all respects, it can be reliably estimated that in the years immediately preceding the war the industry was producing an average of just over 2¾ million tons of horticultural foodcrops from a "cropped" area equivalent to some 621,000 acres, and that towards the end of the war production was running at the rate of over 3¼ million tons from the equivalent of 736,000 acres. In other words, a straight average yield of approximately 4½ tons per acre has been maintained over the whole period taking all crops together. This has a special significance because experience teaches that yields per acre generally decline as area increases.

Figures of acreage or numbers of trees may not by themselves mean very much, and their increase from year to year gives no guarantee of an increase in total output, for this must always depend upon the ability of the grower and his man. But they can reveal the tendencies which have developed in cropping over the past twenty or thirty years and give general indications of the lines along which it should be possible to maintain that balance of output so essential in modern horticultural production.

THE TREATMENT OF ACARINE DISEASE WITH SULPHUR FUMES

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TRIALS with the sulphur smoke treatment of acarine disease of bees, based on the method originally suggested by J. Rennie[1] and on the later work of O. Morgenthaler[2] were carried out during 1948–49 on a number of diseased colonies in Hertfordshire and Bedfordshire. The method relies on the properties of a dense, sulphurous smoke, produced by the burning of a specially prepared smoker cartridge, which kills the mites in the tracheae of the affected bees without causing permanent harm to the bees themselves.

Seven heavily diseased colonies were treated during 1948 and were kept under observation until May or June, 1949. Six of these trials were started during July or early August when the bees were flying freely, but the seventh was not started until late September when cooler weather was causing the bees to cluster at night.

Each colony was given three puffs of smoke through the hive entrance, in the evening, on ten successive days. The treatment was repeated after an interval of seven days, except in the case of two nuclei which were given one period of treatment. Samples each consisting of 30 bees, were examined before, during, and immediately after, treatment, another sample being taken three weeks later, followed by two more during the spring of 1949.

Instruction in the use of the cartridges was given in the first instance to the owner of the bees, who then continued to apply the treatment for the specified period.

EXAMINATION OF SAMPLES FROM COLONIES UNDER TREATMENT

Each Sample Consisted of 30 Bees

Colony		Treatment Started 1948	No. of Diseased Bees in Sample		No. of Mites Found		No. of Diseased Bees in Sample After 2nd Treatment	No. of Mites Found		No. of Diseased Bees in Subsequent Samples	
No.	Size		Before Treating	After 1st Treatment	Dead	Alive		Dead	Alive	3 weeks after Treatment	Spring 1949
A.1	3-Comb Nucleus	July 9	29	7	9	Nil	No Second Treatment Given			Nil	Nil
A.2	Two Ten-Comb Brood Chambers	Aug. 23	30	5	24	6	4	9	Nil	Nil	Nil
B.1	One Ten-Comb Brood Chamber and a Super	July 26	30	30	144	40	1	2	Nil	Nil	Nil
B.2	One Ten-Comb Brood Chamber and a Super	July 26	No Sample Examined	3	25	5	Nil	Nil	Nil	Nil	Nil
C.1	5-Comb Nucleus	Aug. 5	28	3	6	Nil	No Second Treatment Given			Nil	Nil
C.2	One Ten-Comb Brood Chamber	Aug. 24	30	21	56	22	2	3	Nil	Nil	Nil
D.1	Two Ten-Comb Brood Chambers	Sept. 29	24	30	226	6	26	Not Counted	3	No Sample Taken	20 Jan. 31

Encouraging Results From the Table on p. 36 it will be seen that those colonies treated during the active season showed no signs of disease in samples taken shortly after treatment, and there was no recurrence during the period of observation.

The nucleus A1 had to be transferred to a larger hive during May, 1949, as it was attempting to swarm from the four-comb box in which it had been wintered; in all other instances the colonies were reported to be doing well.

In the late season trial (D1) it will be noticed that mites were still present at the end of January, 1949. The colony was then "Frowed"* during February in a further attempt to eradicate the disease. Three weeks after "Frowing" signs of disease and live mites were found in ten bees out of a sample of forty examined. Methyl salicylate was then placed in the hive, but the disease, together with the various treatments, had so weakened the colony that to avoid robbing and thus spreading the infestation to other stocks in the apiary it was later destroyed. Better results might have been obtained in this instance if the smoke had been applied during the daytime when the bees were more evenly dispersed over the combs (thus allowing the smoke to reach the individual bees more readily) rather than in the evening when the rapidly falling temperature was causing them to cluster. It is unlikely that the few bees flying on any one day in the autumn would escape treatment on ten successive days.

The following suggestions are made as a result of the experience gained in carrying out the trials:

Preparation of Smoker Cartridges. The original method of preparation devised by Rennie involved the use of carbon disulphide, which is not only expensive but also evil smelling and highly inflammable. The following method, using glue-size, has been found to be cheap, simple and effective.

Cut corrugated brown paper strips about 3 inches wide, cutting across the corrugations. Dissolve 6 oz. of potash saltpetre (potassium nitrate) in one pint of water (150 grm. in 500 cc). Soak the strips in the solution and hang up to dry. Dissolve 2 oz. of glue-size in one pint of hot water and stir the hot solution into enough flowers of sulphur to make a thick smooth paste. Apply this to the prepared strips with a paint brush, brushing the sulphur well into the troughs between the corrugations. Set the strips aside to dry off, but roll up into cartridges while still damp in order to retain as much sulphur as possible between the corrugations. Bind with adhesive paper tape, allow to dry completely and store in a dry place until required for use. The cartridges should be made to fit snugly into the smoker, preferably a small one of the straight-nosed English type.

Time of Treatment. Apparently the treatment is most effective if given during the active season; moreover, it appears to have no harmful effects on the bees, queen, brood or honey if carried out during this period, and there is no danger of robbing. Where acarine disease has been diagnosed from the examination of a sample, it is suggested that the treatment might usefully be applied during the latter part of the season *before the bees begin to cluster.* Used in this way the treatment can be regarded as a valuable method of attacking the disease when other methods may not be appropriate or immediately practicable. If the disease is discovered in late August, for example it is preferable to use sulphur smoke at once rather than rely on immediate results from the use of methyl salicylate, or to wait until the Frow mixture could safely be given in the autumn.

* A treatment devised by Mr. R. W. Frow which consists of putting into the hive during the resting period a felt pad saturated with a mixture of nitrobenzene, safrol and petrol.

Method of Application. Some casualties have been found to occur among bees at or near the entrance of the hive receiving the full effect of the hot smoke as it leaves the nozzle of the smoker. To avoid this, the colony should be prepared for treatment by placing an empty super or eke below the brood chamber, so that bees on the lower parts of the combs are well away from the entrance.

The method used in the trials—three puffs of smoke daily, in the evening, for ten successive days, followed by a ten days' similar treatment after an interval of seven days—has given good results, but it is possible that equally good results could be obtained by shortening the period of treatment. To obtain information on this point a further trial was started on a badly diseased colony. Three puffs of smoke were given each day for two periods of five days only, separated by an interval of four days. In samples taken following the treatment no live mites were found; but owing to unforseen circumstances, it was not possible to keep the colony under observation, and further samples were not obtained. Consequently the trial, although encouraging as far as it went, must be regarded as incomplete. Further experience is needed, but in any event a rep tition of the treatment after an interval of a few days is desirable in order to kill mites hatching from eggs which survive the first series of smokings.

Before giving the puffs of smoke the bellows of the smoker should be worked until the combustion of the cartridges produces a dense cloud of yellowish fumes. One cartridge will serve to treat several hives on one day.

Acknowledgment is made to the following beekeepers who readily made their bees available and co-operated so willingly in these trials: Mr. C. L. Rawlins, Biggleswade, Beds., Mr. A. J. Rayner, Flitwick, Beds., Mr. V. N. H. Pocock, Tring, Herts., Mr. R. D. Morton, Hitchin, Herts., Mr. C. D. Bingham, Berkhamsted, Herts., the late Mr. J. S. Howard, Biggleswade, Beds.

References

1. RENNIE, J. Acarine Disease in Hive Bees, its cause, nature and control, *North of Scotland College of Agriculture Bulletin No. 33*, 1927.
2. *Bee World*, 1948, **29**, 33-4.

FOUL BROOD DISEASE OF BEES ORDER 1942

SUMMARY REPORT 1949

As has been the case each year since full returns were first compiled by County Agricultural Executive Committees in England and Wales, there has in 1949 again been a substantial increase in the number of apiary inspections made under the Foul Brood Disease of Bees Order, 1942. This further increase over the high figures for 1948 can be ascribed to the long periods of fine weather suitable for inspection work which occurred throughout the active season, and to an increase in the number of Appointed Officers available for duty (708 in 1949, compared with 588 in 1948). Short courses of instruction for Appointed Officers were given by the National Agricultural Advisory Service at meetings arranged by the County Agricultural Executive Committees of Hertfordshire, Kent, Lincolnshire (Holland, Kesteven and Lindsey), Nottinghamshire, E. Suffolk, W. Suffolk, Surrey

and E. Sussex. The result has been a widening of the territory covered by the inspections and an increase in the number of cases of Foul Brood confirmed, though the incidence of disease per hundred colonies examined remains at the relatively low level recorded in 1947 and 1948. During 1949 the total number of apiaries visited by Appointed Officers was 18,950, in which they examined 84,100 colonies. Foul Brood was found in 1,143 apiaries and in 2,437 of the colonies examined:

	1944	1945	1946	1947	1948	1949
Apiaries visited	6,600	9,300	10,900	12,400	14,500	18,950
No. in which Foul Brood was found :						
American F.B.	995	930	795	845	919	1,101
European F.B.	20	11	24	43	21	42
TOTAL	1,015	941	819	888	940	1,143
PERCENTAGE OF INFECTED APIARIES	15.4	10.1	7.5	7.2	6.5	6.0
Colonies examined	26,500	35,200	45,200	52,000	61,600	84,100
No. in which Foul Brood was found :						
American F.B.	1,802	1,602	1,357	1,361	1,840	2,364
European F.B.	43	30	52	145	40	73
TOTAL	1,845	1,632	1,409	1,506	1,880	2,437
PERCENTAGE OF INFECTED COLONIES	6.9	4.6	3.1	2.9	3.0	2.9

The cumulative effect of a persistent policy of maintaining a high level of inspections in areas where disease was discovered in previous years, together with the destruction of the colony in cases where Foul Brood is confirmed, is again shown by the figures for the more active counties.* The incidence of Foul Brood per 100 colonies examined, calculated year by year for the combined territory represented by these active counties, is as follows:

1944	1945	1946	1947	1948	1949
7.1	4.3	2.9	2.7	2.1	1.9

European Foul Brood Of the total of 73 cases of European Foul Brood recorded in 1949 there were 2 in Carmarthenshire, 8 in Dorset, 1 in Essex, 19 in Hampshire, 1 in Norfolk, 1 in Surrey, 2 in W. Sussex and 39 in Wiltshire. Those in Carmarthenshire, Essex and W. Sussex and two of those in Dorset were all from apiaries belonging to beekeepers who bought bees from infected apiaries in Wiltshire in 1946†. Spread of disease from this source has therefore not yet been entirely checked and further inspections of apiaries to which bees were sent from Wiltshire in 1946 are desirable in 1950. All the colonies now maintained by the commercial beekeeper concerned were again examined in 1949, when no evidence of Foul Brood, either European of American, was found.

The 39 cases of European Foul Brood found in Wiltshire in 1949, together with those found in the county during the two preceding years, formed the subject of a special report from the Wiltshire Agricultural Executive Committee. The conclusion is drawn that there must have been a spread of the disease from some of the centres of infection discovered in 1946, in stray swarms taken by local beekeepers, or in swarms from "wild" colonies origin-

* Summary Report 1948. *Agriculture* 1949, **56**, 236-9.

† Summary Report 1946-47. *Agriculture*, 1948, **55**, 88-90, and Summary Report 1948. *Agriculture*, 1949, **56**, 236-9.

ating from these centres; also that some spread may have occurred by "robbing" from the central depot to which honey from the commercial apiaries involved in the 1946 outbreak was taken for extraction.

Sulphonamides and American Foul Brood Two cases of American Foul Brood were confirmed in 1949 in an apiary in Wiltshire used for a trial of the sulphonamide treatment in 1946*. One of these cases occurred in a colony which was treated then, apparently with success, and the other in a swarm which emerged from this colony. One case of American Foul Brood occurred in an apiary in Warwickshire containing colonies which had been moved from premises on which another of the 1946 trials was carried out, though the colony concerned was not identified with any of the individual colonies treated at that time.

OUTWINTERING ON SAND

N. F. McCann, B.Sc., N.D.A.

County Agricultural Officer, Nottinghamshire

IN medieval days practically the whole of the west side of Nottinghamshire was covered by the Forest of Sherwood, renowned throughout the world for its association with Robin Hood. It is an area of very poor, thin sand land, which presents many difficult and – too often unfortunately – insuperable problems to the farmer. The principal problem is, of course, that of maintaining fertility on a soil which has very little humus in it and which, if left uncovered during dry spells in the spring and summer, may quite easily blow away. Traditionally, fertility was maintained by the old Norfolk rotation with a one-year break of seeds every four years, and with sheep eating a crop of roots on the ground, manuring and consolidating the land in preparation for barley.

Because of the relatively low returns from sheep fed in this way and the difficulty of finding labour to take an interest in the sheep, as well as perform the daily task of moving the fence, this system has virtually disappeared and, between the wars, it is sad to have to report, so did many of the farmers who relied upon it. Much of the land began to go derelict, but the impetus provided by the food production campaign during and since the war stimulated efforts to bring this poor marginal sand land back into cultivation. Without the sheep, new methods of building up and maintaining fertility had to be devised, and one of the farms where new ideas have been put into operation is that of Mr. A. E. Singleton, Oxton Grange, near Nottingham. This is not wholly a sandland farm, but it has some very interesting features in connection with the outwintering of cattle and the reclamation and improvement of sand land that makes it of interest to all farmers who have any connection with the bunter sandstone or similar formations.

Sand into Ley Mr. Singleton is farming about 890 acres of land altogether, of which rather more than 300 acres are pure bunter sandstones. The remainder of the farm is partly keuper marl and partly keuper sandstone or waterstone. It is not all clay but there is a certain amount of

* Milne, P. S. Sulphonamide Treatment of American Foul Brood. *Agriculture*, 1947, **54**, 82-7.

quite strong clay on the higher parts of the farm. The whole area, however, is run as one farm and the rotation is very elastic. There are only 24 acres of permanent grass left in the 890 acres—a piece around each of two homesteads and one unploughable hill. Very soon the paddocks around the homesteads will be ploughed up. Mr. Singleton was compelled to adopt a ley-farming policy because the permanent grassland was just not good enough; on the clay it was thickly matted, and on the sand it did not exist; it was merely a growth of weeds where the grass should have been. Mr. Singleton started about twenty years ago with 400 acres of land. He took a further 200 acres in 1936 and the remainder after war broke out, including about 220 acres of derelict land, part of it on the sand and some of it on the clay. The reclamation of the sand land was carried out in various ways, but the most satisfactory system was a thoroughly good ploughing followed by a crop of rye, two consecutive crops of roots, such as turnips and kale, and then seeding down without a nurse crop. Some of the land was seeded down with S.143 cocksfoot, S.100 white clover, plus a pound of wild white clover. Other areas were sown with lucerne and cocksfoot, and this latter mixture made a first-class sward, although, contrary to the generally accepted principles of managing lucerne, it had to be grazed in its first year. Naturally these crops would not grow without help, and a tremendous quantity of waste lime from the local sugar beet factory has been applied. Some of the fields put down with cocksfoot and S.100 or lucerne and cocksfoot, in the early 1940s, are still there, and the lucerne is by far the better crop. In Mr. Singleton's opinion, by the way, ryegrass is useless on this sand land.

One of the advantages of this poor, dry land is that it is first rate for outwintering cattle. Mr. Singleton puts all his straw on to the leys in large round stacks not less than 20 yards in diameter and not very high. The cattle eat at these as and when they like and the stacks gradually assume the shape of giant mushrooms, until, eventually, when the "stalk" gets too thin, they are pushed over and the debris spread over the field. These mushroom stacks may stay on the field for over twelve months, and it is noticeable that the cattle still eat at them just as readily in the spring when the grass is lush as they do during the winter when there is no grass to graze.

The elasticity of the rotation is shown by the fact that during the war the acreage of corn crept up to 450, and it may eventually come down to about 200. Root crops are limited to some extent by labour difficulties, but in 1949 Mr. Singleton grew 30 acres of sugar beet and 40 acres of potatoes. He intended to have grown another 30 acres of potatoes but, because of difficulty over seed, he grew instead 30 acres of tares and oats for silage. He grows no roots at all for his livestock, and in fact the mainstay of their ration is silage made from the leys, tares and oats and lucerne. The cropping for 1949 was 360 acres of cereals, 45 acres of silage mixture, 70 acres of sugar beet and potatoes, 10 acres of bare fallow, 150 acres of seeds for silage, and 255 acres of seeds for grazing. The average length of ley is about five years, but there is no hard-and-fast rule. On the better land the leys stay down as long as they are useful. Besides growing no roots for his livestock, Mr. Singleton makes no hay and in fact, during the winter, practically every animal on the place over a year old lies out on the sand land and is fed with sugar beet tops, silage and straw.

Milk-Beef The dairy herd consists of two or three cows, and their produce is devoted to the families—Mr. Singleton's and others—living on the farm. The breeding herd consists of about 60 cows and heifers, Blue Greys and Lincoln Reds, which are mated to two pedigree Aberdeen-Angus bulls. Mr. Singleton's idea is to reduce labour to a minimum, and

for this reason he prefers the fairly big Lincoln cows mated to the Angus bull so that he may expect no difficulty over calving. As he says, he likes to go out before breakfast to see the new arrivals and after tea count them! These cows and heifers calve in February and March, an early date chosen deliberately so that the cows do not produce so much milk as to require special attention when the flush of grass comes. Each cow rears one calf, and by the time the cows get the benefit of the spring grass the calf is strong enough to deal with the milk. Multiple suckling is not practised—on the grounds that the saving in labour makes it more economical to rear one calf per cow. After about the fifth calf the cows are fattened off and are usually graded in June, fifteen months after the last calving. The calves are kept on the cows till about Christmas, i.e., 9 or 10 months old—here again with the deliberate intention of reducing the risk of the cows calving down with a big flush of milk. The calves are kept in after weaning until April, and they then run out of doors continuously until they are just over three years old, being sold fat off the grass about June. Actually this class of cattle started off in this way will sell fat at almost any time, and they can, of course, be wintered indoors in their second year and sold fat from the yards; but the object is to avoid unnecessary indoor feeding. Apart from the months of January to April round about their first birthday, the cattle live out of doors; no troughs are used and the food is thrown down from carts. The nurse cows are never indoors, except for the fortnight when the calves are weaned; and even in the very severe winter of 1946-47, when snow lay on the ground for about six weeks, the cattle continued to do remarkably well on the diet provided.

The whole scheme is designed to cut down the demand for labour because this big farm carries very few cottages and has no nearby source of regular workmen. The present staff totals eleven men and boys, of whom six could be described as able-bodied adults, plus four European Volunteer Workers from a nearby Agricultural Committee hostel.

Adaptability of the Ley Obviously there is very little farmyard manure made, and what there is usually goes on to the sugar beet. The potatoes are often grown after leys and have to go without muck. The whole basis of fertility on this farm is the ley and, particularly, the lucerne ley, but in addition to this immense contribution to fertility, there is a great advantage in the ley system in that it is thoroughly adaptable. If the cry should be for more corn or more roots, then more leys can be ploughed without upsetting the general principle of the rotation. If fat cattle are wanted the leys can be left down for an extra year or two and more cattle maintained. Examples of the sort of land that Mr. Singleton had to tackle still exist, although fortunately in only small areas; we can still find bits here and there covered with scrub birch, gorse, bracken, or even heather to compare with Oxton Grange as it is today. During the dry summer of 1949 Mr. Singleton's lucerne leys—surrounded as they are by a large area of the bunter sandstone land—looked literally like an oasis in a desert, and at all times of the year the large numbers of cattle carried on this poor sandy soil are a source of wonderment to the passing motorist.

There is a lesson to be learned here by everybody who has to manage this class of land, and the National Agricultural Advisory Service has arranged a demonstration of the system and its results for April 14, 1950. Anyone interested in sand land will there find much of interest.

FEBRUARY PRICE REVIEW

Statement made by the Minister of Agriculture and Fisheries to the House of Commons Thursday, March 23, 1950

In accordance with Section 2 of the Agriculture Act, 1947, the Agriculture Ministers have, in consultation with the National Farmers' Unions of England and Wales, Scotland and Northern Ireland, undertaken a review of the general economic condition and prospects of the agricultural industry. Among the matters which have been considered are the already announced increases in prices of feeding stuffs as from April 1 and of fertilizers from July 1. These and other additional costs of production have been considered in relation to the statistics of aggregate farmers' net incomes, as published annually in the White Paper on National Income and Expenditure. The whole review has taken place against the background of the national economic position.

The conclusions which the Government have reached in the light of the review fall into three parts:

First, increases are to be made in the prices for milk, fat cattle, fat sheep and fat pigs, with effect roughly from April 1, 1950. Acreage payments for potatoes and rye will be discontinued as from and including the 1951 harvest, but there will be price increases for main crop and second early ware potatoes. Prices of the other principal crops will not be increased.

Second, from July 1, 1950 schemes will operate in the United Kingdom to assist farmers in the purchase of fertilizers used for improving grassland and marginal land.

Third, there will be extensions in the near future to the Marginal Production Schemes in England and Wales, Scotland and Northern Ireland, for the purpose of assisting certain classes of the smaller producers of milk, pigs and eggs in respect of their purchases of feedingstuffs, and partly to speed up the rehabilitation of semi-derelict land and other similar activities eligible under the existing Marginal Production Schemes.

The cost of these new or extended improvement grants will in a full year be approximately £7 millions. They therefore constitute a major element in the Government's decisions arising from the Price Review. The leaders of the National Farmers' Unions have indicated their acceptance of these decisions both in general and in relation to the separate components which I have outlined. Their concurrence is prompted by a desire to avoid an undue rise in prices to the consumer and to concentrate a substantial part of the relief from additional costs on those farmers most in need of assistance.

The Agriculture Act, 1947, also requires Ministers to determine and announce during 1950 minimum prices for milk, fatstock and eggs in 1952/53 and 1953/54, but by agreement with the Farmers' Unions consideration of this subject has been deferred on the understanding that decisions will be reached within the next two months.

I am circulating with this answer a statement giving the main features of the new price schedules and an outline of the proposals for assisting the purchase of fertilizers and extending the Marginal Production Schemes.

Following are the further details :

Livestock and Livestock Products

Milk. The present average U.K. pool price will be increased by an average of seven-eighths pence per gallon. In addition the production bonus in England and Wales of 1½d. per gallon on the first 400 gallons per month in the winter will be increased by the equivalent of a further 1½d. a gallon in the winter months. Corresponding additions will be made in Scotland and Northern Ireland.

Fat Cattle, Sheep and Pigs. The following price increases are subject to grade and/or seasonal variation.

Fat Cattle. There will be an overall average increase of 2s. per live cwt.

Fat Sheep. There will be an average increase of ½d. per lb. of dressed carcase weight for fat sheep and lambs.

Fat Pigs. There will be an average increase of 4s. per score lbs. deadweight.

Hen Eggs. No change in the average annual price of 4s. 1d. per dozen paid by packing stations.

Duck Eggs. There will be a reduction of 4d. per dozen in the average price.

The practicability of introducing in future years a system of payment for eggs according to weight grades will be examined during the next few months by representatives of the Agricultural Departments, the Ministry of Food and the Farmers' Unions.

Crops

The following changes in crop prices operate with the 1951 harvest.

Potatoes. The acreage payment will be discontinued. Sound and marketable potatoes sold on or after August 1, 1951, will receive an average price increase of 39s. per ton.

Sugar beet. No change.

Wheat. The existing price will continue, but may, after consultations with the Farmers' Unions, operate as a guaranteed minimum price.

Barley. (i) There will be no maximum price for malting barley.
(ii) The current feeding barley fixed price of 21s. 6d. per cwt. will be a minimum price. The application of a seasonal range to this minimum is under consideration.

Oats. There will be no maximum price for milling oats.

Rye. The acreage payment will be discontinued and a partial compensatory adjustment in the price of rye offered for sale for human consumption will be discussed. The guaranteed minimum price for rye will be reduced to 21s. 6d. per cwt.

Scheme for encouraging the use of Fertilizers for Improving Grassland and Marginal Land

This will be in two parts :

(a) There will be grants on the application to grass, including rough grazings and similar marginal land, of fertilizers acquired after July 1, 1950, i.e., the beginning of the first stage of the removal of the present Board of Trade subsidy. The grant will be one-third of the farmer's actual expenditure on the purchase of fertilizers up to a maximum of 25s. per acre, limited in any one year to one half of the total area of grass on each farm. The grant will not be approved by the County Agricultural Executive Committee if the area under crops on the farm is considered insufficient. Either permanent or temporary grass will be eligible, excluding grass sown as one year ley which is now regarded as a tillage crop.

(b) Grants on the application of fertilizers after the ploughing up of grassland of at least seven years standing. The rate will be two-thirds of the actual expenditure up to a maximum of £3 per acre.

These details of the schemes apply only to England and Wales ; some modifications will be needed for Scotland and Northern Ireland.

Extension of Marginal Production Schemes

The Marginal Production Schemes in the three countries will be extended to afford relief to farmers who are in a small or moderate way of business producing milk, pigs or eggs, where these commodities constitute the major part of their gross farm income, and whose farms are of such a nature by reason of position, size, soil or permanent equipment that they are heavily dependent on purchased feeding stuffs and have little opportunity by grassland improvement or otherwise to make their holdings reasonably self-sufficient.

County Agricultural Executive Committees in England and Wales will be authorized to pay a proportion of the cost of farmers' purchases of feeding stuffs. Administration in Scotland and Northern Ireland will take a somewhat different form.

The existing Marginal Production Schemes in England and Wales and Scotland will also be extended in other directions. In England and Wales there will be a relaxation of the existing means test, and in both countries there will be additional provision for reclaiming semi-derelict land of the following chief descriptions : old ridge and furrow grassland which is difficult to cultivate in its present condition ; grassland covered by light scrub, anthills, rushes, etc. ; and small areas of felled woodland if they are of high potential value for grass or tillage. Each application in England and Wales will be examined separately by the County Agricultural Executive Committee, and a similar extension suitably modified will be operated in Scotland.

BOOK REVIEWS

Feeding of Livestock. STEPHEN J. WATSON. Nelson. 12s. 6d.

It is often stated that half the pedigree of an animal goes in at the mouth, and there is no doubt that feeding has a profound influence on the growth and development of an animal and on what the animal will produce in the form of milk, meat, bacon, eggs or work. Many books on animal nutrition and feeding seem to deal either with the fundamental principles of nutrition to the neglect of their practical applications, or with practical guidance on the art of feeding with scanty reference to the scientific principles on which the art is based. Professor Watson, who is well known both for his scientific work and for his practical expositions of the art of feeding, has, in this very readable book, combined both sides of his wide experiences. He has produced a book which should appeal both to the student of agriculture and to the practical man who wants to know something of the fundamental principles on which his feeding of his livestock is based. The treatment of the subject matter, whilst very comprehensive, is given with an admirable simplicity; on many nutritional matters about which there may be more than one opinion the facts are clearly presented without conscious bias or undue dogmatism.

The book is divided into three principal sections. In the first the author sets out concisely and clearly the principles of nutrition, ranging from the chemical constituents of foodstuffs and animal products, through an account of the changes undergone by these constituents in the course of digestion and subsequent metabolism, to the determination of digestibility and of nutrient and energy balance. The various systems of evaluation of feedingstuffs are explained, including those of net energy, starch equivalent and fodder units. The second section comprises a discussion of the various types of feedingstuffs and their uses, whilst the third is devoted to a more detailed consideration of the feeding of individual classes of livestock. Finally, there are some very useful Tables of the composition and nutritive value of the principal feedingstuffs and of their mineral contents.

There is a wealth of material in this handy little book, which should make a strong appeal to all those whose activities are concerned with the feeding of livestock. The story is developed in a concise, logical manner, and is told with an admirable simplicity of style that makes the whole book so very readable. This is a most useful work, which can be well and worthily recommended to both the student and the practical farmer.

A.E.

Field Machinery. CORNELIUS DAVIES. Nelson. 15s.

Dr. Davis has presented a clear exposition of the action of many well-tried implements and machines in the field of crop husbandry with, in most cases, a short history of their development and notes on how best to fit them into the economy of the farm. The touch of the experienced lecturer is apparent in the first four chapters, which deal with definitions and general principles. In them the student will find some applied mathematics, descriptions of various machine materials and some details of machine elements which will enable him to understand more clearly the subsequent descriptions of actual agricultural machines. The whole is illustrated in line and half-tone; and they really are illustrations, not mere embellishment. Most of the photographs are provided by manufacturers and therefore show in good detail the special design of each machine. Some of the points emphasized in the photographs refer to one particular make of machine rather than to the type as a whole, but this is balanced in many cases by showing more than one manufacturer's photograph for each type of machine.

The keynote of the book is its *soundness*. I feel that Dr. Davies said to himself that he must be careful not to let the reader become too enthusiastic over new, elaborate machines, however ingenious they may be and whatever the labour-saving hoped for by the inventor. When an expert writes a book it is usual for the parts of the subject into which he himself has made research to be treated in a more interesting way than the other parts, and the reader will detect in this book the notes of the first-hand worker in the short sections on fertilizer deposition and sprayers.

H.J.H.

Farm Soils: their Management and Fertilization (Fourth Edition). EDMUND L. WORTHEN. John Wiley, New York (London, Chapman and Hall). 19s. 6d.

Farmers and students in the U.S.A. will welcome the fourth edition of this sound and comprehensive textbook, now expanded to 100 pages beyond the original 1927 edition.

The main lay-out of the third edition has been retained, the major innovation being the rearrangement and enlargement of the section on erosion control—a change which is amply justified. Considerable care has been given to revision of material dealing with cultivation practices and the use of fertilizers. In two instances, however, statements could profitably have been modified: the long-accepted theory that cultivation checks evaporation from the soil surface has been seriously challenged, and the use of farmyard manure has been shown to stimulate the uptake of inorganic nitrogen by crops.

One or two chemical and physiological statements might have been more happily expressed, but admittedly they do not directly concern the main business of the book, which has excellent qualities to recommend it to agricultural students. Not the least of these is the author's subtle means of emphasizing the most important points by reintroducing them in different contexts.

K.C.

Chemistry of Insecticides, Fungicides and Herbicides (Second Edition). D. E. H. FREAR. D. Van Nostrand Co. Inc. (New York). 33s.

It is with pleasure that we record the appearance of the second edition of the book by Professor Frear of the Pennsylvania State College. The first edition was published in 1942. At that time research, stimulated by war conditions, was actively in progress, but the new era in pest control methods had hardly begun. The advent of DDT, however, was soon followed by the discovery of other chemicals, some of great complexity, which were found to be of value as insecticides or fungicides, while the recognition of the selective herbicides resulted in important advances in our methods of weed control.

The second edition has been rewritten almost completely in the light of the new developments. Main chapters are devoted to inorganic insecticides, naturally-occurring insecticides, synthetic organic insecticides, fumigants, inorganic and organic fungicides, and to spray adjuvants and the removal of toxic residues. A chapter on the inorganic and organic herbicides, not dealt with in the first edition, is included. Analytical methods for some of the older-established insecticides and fungicides and methods for the determination of some spray deposits are also given. Each chapter is followed by a list of useful references.

The book is attractively produced and may be recommended as a valuable work of reference to the nature and properties of the many chemicals now used for the control of pests, diseases and weeds.

J.T.M.

The Fruit Year Book, 1949. Royal Horticultural Society. 8s. 6d.

This volume, the Society's third *Fruit Year Book* maintains—many will think surpasses—the high standard set by the first and second issues. It contains 30 articles and notes by contributors of acknowledged standing, together with notices of some 15 books published during 1949 and other miscellaneous items of information.

The unique value of this issue of the Year Book lies not only in the comprehensive manner in which information relating to modern fruit-growing practice in Britain is given but also in the authoritative accounts of fruit culture in Victoria (Australia), New Zealand, South Africa and British Columbia. A reading of these well-written articles is an education in the horticultural development of the far-flung Dominions of the British Commonwealth and provides food for much thought. In this respect the article by Mr. J. P. Hudson, entitled 'Tree Fruits in New Zealand's Homes and Orchards,' is particularly interesting. One is left with the tantalizing thought that after all that has been said on the subject, there may yet be an unsolved mystery about Cox's Orange Pippin, which in New Zealand, we are told, ripens at the beginning of the apple season. For Mr. Hudson writes: "Most of the varieties of apples grown commercially, with the possible exception of Delicious are *self-fertile* under New Zealand conditions, where it is not necessary to interplant the main varieties with rows of pollinators". Presumably this statement embraces Cox's Orange Pippin which, as everyone knows, is a notoriously self-*infertile* apple under our conditions. Have we something still to learn about this temperamental variety?

Readers with a scientific turn of mind will find much to interest them in Mr. M. B. Crane's article 'The Origin of the Garden Plum' and Dr. L. C. Luckwill's article 'Hormones in the Fruit Garden'. Those looking for new fields of fruit-growing interest cannot fail to find Mr. R. Barrington Brock's article on open air vine culture, 'Viticulture in England,' exceptionally rewarding. Perhaps we shall yet see peach orchards and vineyards gracing the landscape of our homeland!

While it is invidious to select any contribution for special mention from among so many that are meritorious, a great many readers of this issue of the *Fruit Year Book* will be gratified to see that it includes a felicitously worded tribute by Mr. M. B. Crane to the work of Mr. Edward Laxton as a raiser of new fruits. As Mr. Crane rightly says: "During the present century there has been scarcely a year go by without the introduction of a fruit bearing the name of Laxton". A pleasing portrait of Mr. Laxton forms the frontispiece of this useful volume which contains also 43 photographic illustrations and a remarkable coloured plate of strawberry varieties.

A.H.H.

English Cottage Furniture. F. GORDON ROE. Phoenix. 12s. 6d.

In how many farmsteads throughout the country, I wonder, are there lying, all unregarded, old period pieces which would gladden some collector's heart? Handed down from generation to generation or picked up perhaps in a local dealer's or at an auction sale, that old chest or stool, or maybe a desk or table, has found its way to the kitchen or an outhouse, there to serve out its time in menial use with the austere and mass-produced furniture of the present age. That such things happen (if rarely !) is supported by the author's reference to an old chair-table which stood for several generations in the outhouse of an East Devon cottage. It came under the hammer at a local auction. The top had been nailed to the arms, and the lidded box-seat had been used to hold potatoes. It went to the one and only bidder—for threepence !

If Mr. Roe's book should fail to awaken an interest in the real old cottage furniture, that is not a fault which can be laid at his door, for one does not have to be an antiquary to appreciate the beauty wrought in wood which he describes so well. The author moves among his pieces with the loving care of a connoisseur, pointing out the country manifestations of Chippendale, Sheraton, Hepplewhite, Adam and Regency chairs, a Gothic boarded chest and Tudor box-seated settle, a seventeenth century gate-legged table and ornamented Bible-box. He spurns the spurious with the sure instinct of the man who knows his subject, and corrects the fallacies which too often impose upon the credible.

Panelling, clocks, "courting pieces," pewter, brass and copper are also described, and who, at one time or another, has not been fascinated by the firelight flickering on old metal, evoking history from its polished surface?

There is a quality in bygone styles and fashions, no doubt despised in their own time, which gives a pleasure not easily defined. In them, and often the painstaking craftsmanship of which they are examples, is embodied some of the spirit of that more leisurely England which saw no reason to divorce beauty from utility.

S. R. O'H.

Beekeeper's Folly. JOHN R. RATCLIFFE. Macdonald. 15s.

Mr. Ratcliffe, as a beekeeper who, to quote the words of his preface, "has not quite forgotten the early enthusiasms and uncertainties" of the beginner, has written a book which is not only a helpful guide for the keen novice, to whom it is primarily addressed, but also a critical digest of experience which can be read with interest and profit by the advanced worker seeking to improve his own methods by a comparison with those of others.

There are useful chapters on how to make a start on rational lines, how to select a site for the apiary and how to choose the equipment. Methods of making increase, swarm control and queen rearing are described and compared in some detail. The fact that things do not always go according to plan is never lost sight of, and one chapter is devoted to ways and means of overcoming snags that are likely to arise. The author clearly recognizes, too, that successful beekeeping depends upon an intelligent survey of the sources from which bees gather nectar and pollen within an economic flight range of the hives no less than upon the care devoted to the apiary itself. His chapters on bee forage crops and migratory beekeeping are a valuable feature of the book, and are worthy of careful attention by all beekeepers contemplating moving bees to increase the scope of their activities, either for pollination purposes or for honey production.

The numerous illustrations are well produced. There is a glossary of terms, an appendix containing useful facts and figures for reference, and an adequate index.

P.S.M.

The Honeybee. C. G. BUTLER. Oxford University Press. 10s. 6d.

The author modestly describes his work as an introduction to the sense-physiology and behaviour of the honeybee. It is, in effect, an outstanding work on the subject.

Dr. Butler has collected the research in this intriguing field, of workers of repute, including that of Professor K. von Frisch, and where necessary commented on the conclusions; and it is pleasant to see his own work also recorded. The methods by which investigations are carried out, the use of controls, and the careful manner in which the results are assessed and concrete conclusions reached should be studied by all workers in apiculture.

In addition to the chapters surveying the knowledge of the senses of vision, smell, taste and methods of communication, there are sections on the collection and utilization of propolis, water, pollen and nectar. Singling out items, it is shown that the honeybee possesses a well-developed sense of time, recalling from day-to-day the times food is available, and it is possible that bees that seek food from one particular source at a particular time of the day idle away the remaining hours in a remote part of the hive!

Referring to the work of von Frisch, Dr. Butler emphasizes that this worker carries out his operations in the field and not under simulated laboratory conditions—a method which adds weight to his findings. Of particular interest is von Frisch's conclusions, based on

work with bees whose antennae had been amputated, that the principle olfactory organs of the worker honeybee are situated on the eight terminal segments of the antennae.

The water-perception sense of the honeybee, her choice of water, and the use of water within the hive, forms another intriguing chapter. The water is mainly used for preparation of food for the larvae, and is not normally stored in the hive. A clear account is given of the collection, ingestion, and digestion of pollen; and the chapter on nectar and its transformation into honey should enlighten many to whom the latter is a complete mystery. Possibly the chapter on the behaviour of the honeybee in the field, containing as it does much of the author's own work, will have the greater appeal to the ordinary beekeeper.

Other features of the book are the ample bibliographies provided at the end of chapters, making for easy reference; and an adequate author and general index at the end of the book. The photographs are of a high standard.

Although the author states that his book is definitely not a textbook on beekeeping, it is a book which should be in the possession of all beekeepers who have the interests of the craft at heart. By constant perusal of this work they will gain a better understanding of their insect charges, which will be to the benefit of both bees and beekeeping.

G.A.C.

Poultry on the General Farm. C. W. GOODE.

Small-Unit Poultry-Keeping. W. POWELL-OWEN.

Poultry Plant Maintenance and Design. W. MOORE.

Shell—B. P. Farm Service. Free from Shell-Mex and B.P. Ltd.

Farmers are able to provide poultry with conditions which are as natural as possible under domestication, and there is abundant evidence that poultry on a mixed farm are not only conducive to the increase of crops without the application of expensive artificial manures but in many ways there is, as a result, an increased abundance of feed for the birds in its freshest and best form. Not only so, but the danger of contaminated soil by excess manure can be avoided. In *Poultry on the General Farm* Mr. Goode has managed to a remarkable degree to compress within the small compass of 28 pages the sort of advice that many farmers, who are about to introduce a flock of fowls on to their holdings for the first time, are most in need.

The information provided has been handled and presented in a pleasing and readable style that is a high tribute to the skill, knowledge and experience of its author. It is surprising that so many aspects of poultry on the farm are dealt with satisfactorily in such limited space; even so the advice given seems to gain by the fact that it has been reduced to the quintessence of the subject.

The two most outstanding sections cover the various systems of housing poultry and the routine management which includes feeding, rearing and culling the flock. Much of the advice is aimed at the elimination of waste, especially in feeding; the reduction of labour and the control of the health of the birds. Whilst the booklet is addressed particularly to farmers, much, if not all, of the information given should be of interest to those who keep poultry for a living.

The second booklet in this very useful series is mainly of interest to the back garden poultry-man, and *Small-Unit Poultry-Keeping* should have a very wide appeal. Although the impact of war did much to disrupt the normal functioning of the poultry industry there was one class of poultry-keeper who received very great encouragement; that was the domestic poultry-keeper who during periods of shortage managed, on a small allowance of meal supplemented by house scrap, to provide eggs not only for his own family but often for his neighbour's family too.

W. Powell-Owen has spent almost a lifetime in the service of the small poultry-keeper, and by his long experience and enthusiasm is well qualified to guide the novice in his early attempts to keep a few fowls. The advice given should help many to avoid the pitfalls that beset those who start such enterprises with high hopes but scant knowledge of the elementary principles of backyard poultry husbandry.

Finally the series is rounded off by a third booklet that covers the subject of *Poultry Plant Maintenance and Design*. Although this is a modest little publication that has no pretensions to deal with matters other than those suggested by the title, the advice given on the maintenance of poultry houses and plant is most useful; the author deals with plant preservation and renovation and also discusses the various methods used and materials required in erecting the fences and houses of a poultry plant and keeping them in good repair. The design and construction of small appliances, such as feeding and water troughs, chick houses and movable chicken runs, sun parlours, are all useful and practical suggestions well worth the study of all classes of poultry-keepers.

G.W.S.

Principles of Food Freezing. WILLIS A. GORTNER, FREDERICK S. ERDMAN, and NANCY K. MASTERMAN. John Wiley, New York. (London, Chapman and Hall). 22s. 6d.

That quick freezing is gaining momentum in Great Britain is evidenced by the increased interest taken in frozen products by the retail traders' organizations and by the recent formation of the National Association of Quick Frozen Food Processors. Considerable research is being carried out to find the best varieties of fruits and vegetables for quick freezing, and Grimsby is becoming very active in the adoption of methods for the quick freezing of fish.

Owing to the phenomenally rapid progress of quick freezing in America, it is natural that a copious literature should be built up. One of the latest examples of this is the collaborative effort of three members of the Faculty of the School of Nutrition, Cornell University.

The intention of the book, according to the authors, is not to cover the *art* of food freezing, but to deal with the principles underlying the methods. Although a consideration of commercial operations is included, the major portion of the book is devoted to the home, farm and community equipment, their suitability for various situations, and the problems involved in their use. It is a book written for the student or the newcomer who seeks a preliminary bird's eye view of the industry, and the authors, by their clear method of exposition of general principles, fulfil this want.

There is a certain lack of balance in the book. For instance "Blanching of Vegetables" occupies ten pages while only five and a half pages are allowed for "The Role of Food in Engineering and Design". One-third of the book is devoted to such matters as home freezing locker plants, which are obviously subjects of interest for the moment to American readers.

Considering the huge volume of literature on quick freezing that has been published during the last few years, the references in the book are comparatively few; the authors explain that these have been included merely to substantiate the principles in question and to provide the student with a start in his search in the literature for more detailed information.

O.J.L.

Foot-Path through the Farm. C. HENRY WARREN. Falcon Press. 7s. 6d.

There is no scarcity of arm-chair farm itineries for the uninitiated, and in this respect, therefore, it cannot be said that Mr. Warren has broken any new ground. Where his book scores is in the deft treatment which we have come to expect from this author. Around an imaginary, but representative, Essex farm of some 250 acres, Mr. Warren, with his customary skill, has woven the story of the seasons, the month-by-month jobs of the ordinary arable farm of the Eastern counties, with its emphasis on corn and roots, so that the reader acquires his knowledge almost unawares. At the one extreme, Alfie, the old-timer, sees little good and nothing to praise in present-day farming practices; at the other, Ron, the farmer's son, is impatient of delays in adopting the results of agricultural research; between them stands the farmer himself "who, by no means scorning the aid of science, errs on the side of tradition". The intimate knowledge which a farmer must have of every corner of every field on his land is well brought out; also that throughout his life the good farmer is constantly adding to his experience, never reaching full knowledge, but passing on the best of it to the next generation and so making his individual contribution to what in time comes to be known as "the farming tradition".

S.R.O'H.

Bird Migration (Third Edition). A. LANDSBOROUGH THOMSON, H. F. and G. WITHERBY. 8s. 6d.

Written by our greatest living authority on the subject, this book cannot but command respect from every reader, expert or novice, and it is on the same plane as the late Eagle Clarke's classic work, *Studies in Bird Migration*. This reprint will be heartily welcomed by students who have been unable to get copies of the second edition, the text of which the present issue follows.

Although the author, as was to be expected, is soundly scientific in his approach to, and his treatment of his subject, the book contains something for every student of bird life. The experienced ornithologist will be attracted mainly by the author's views on the reasons offered in explanation of such problems as the migratory impulse, the objects of migration, climatic influences, and so on. The student who is not concerned with the more strictly scientific aspects of bird migration will be thrilled to learn that the Pacific form of the American golden plover regularly and successfully essays a migratory flight of some 2,000 miles, non-stop, across open sea; that swifts have been found easily able to pass and circle around an aeroplane travelling at 68 miles per hour, and that the Gulf of Mexico is crossed

in directions involving flights of 500 miles by that feathered atom the ruby-throated humming-bird.

In this book, we may be sure, is all that is at present known about the migration of birds. The author's concluding paragraph is worthy of notice, particularly by certain "popular" writers who have offered glib and facile answers to these very questions: "What determines the direction and destination of migration flight? What enables the migrant to follow that path to that goal? What, in particular, guides the young birds in those cases where they travel apart from their parents when only a few weeks old, and yet perform a long journey in accordance with the constant pattern of their species? Therein lies the real mystery of migration." *F.H.L.*

The Fruit Farm—Its Establishment and Costs. O. G. Dobey. Faber. 15s.

Many books on fruit-growing have appeared in recent years, the majority of which have been concerned primarily with the purely technical aspects of cultivation, pest and disease control, etc. The book under review is, in short, a detailed account of the establishment of a 60-acre fruit unit at the Essex Institute of Agriculture at Writtle, near Chelmsford, for which the author was responsible, and covers an account of the entire costs involved from planting in 1936 up to 1943, together with full details of crops obtained and cash receipts.

Naturally most of the costing given are now much below present levels, as the author readily admits, but it is possible to arrive at a fair estimate of present-day figures from the mass of detailed information given in the comprehensive and easily followed Tables.

The capital outlay on the farm under review up to the first really profitable year of 1941 (i.e., 5 years from planting) was £100 per acre, and the accumulated debt charge at 5 per cent interest almost £120 per acre. Receipts for 1941 were approximately £3,000 and expenditure £1,200, the farm producing 1,831 bushels of apples and pears, 96 cwt. of plums, and 13 cwt. of black currants. By 1943, receipts had risen to almost £14,000 and expenditure was about £2,000.

The planting plan conformed to the then orthodox current trends. In bush apples—Cox at 18 feet square; on stock M.I, M.II, and M.XIII—pollinated by Grieve at "one-in-nine" on crab' Worcester and Laxton's Superb at 20 feet square on M.I (pollinating each other). Half-standard Bramley on crab at 40 feet square (pollinated by Monarch "one-in-nine") with Bramley bush fillers on M.II at 20 feet square. In addition one acre of Cox Cordons on M.IX and M.II at 7 feet × 2 feet 6 inches (pollinated by Grieve) were planted.

In bush pears—Conference with Laxton's Superb—as pollinator on Quince 'A'.

Plums half-standard, Czar, Purple Pershore, Victoria and Giant Prune on various stocks. At 20 feet square—interplanted black currants.

Although this book is very largely concerned with costs and receipts, there is woven throughout its 100 pages a wealth of solid technical information which could come only from one possessing a wide practical experience of his subject. Practices in the modern fruit-growing world change rapidly, and the author successfully weaves into this absorbing book his ideas of what he would do if planting a similar unit today; e.g., he states that he would never plant dessert apples on "good soil" on vigorous stocks at less than 20 feet or preferably 24 feet square, if the policy were to set out the trees at the maximum distance ultimately required. How many growers now faced with "thinning-out" problems wish they had given more space at planting time.

To the prospective fruit grower this book should prove an invaluable guide. To the established man it will give much food for thought—and reflection. *B.D.A.T.*

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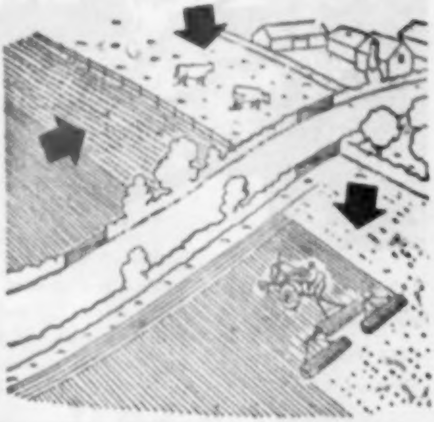

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